Tanzania Wildlife Discussion Paper No. 45
Dr. Rolf D. Baldus (Ed.)

What the Kidunda Dam will Destroy: Ecological and Socio-economic Value of Gonabis, Selous Game Reserve, Tanzania

by

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Dar Es Salaam 2005

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List of Abbreviations

BZs	Buffer Zones
CVM	Contingent Valuation Method
FZS	Frankfurt Zoological Society
GTZ	Deutsche Gesellschaft fuer Technische Zusammenarbeit
KGCA	Kilombero Game Controlled Area
MNP	Mikumi National Park
MNRT	Ministry of Natural Resources and Tourism
MRBZ	Mgeta River Buffer Zone
NTFP	Non Timber Forest Products
PA	Protected Area
SGR	Selous Game Reserve
SRF	Systematic Reconnaissance Flight Survey
TWCM	Tanzania Wildlife Conservation Monitoring
WMA	Wildlife Management Area
WTA	Willingness to Accept
WTP	Willingness to Pay
WPT	Wildlife Policy of Tanzania

Contents

Foreword by Rolf D. Baldus.....3

Acknowledgement.....7

Executive Summary.....8

1.0 Introduction.....11

2.0 Literature review

2.1 Definition and function of buffer zone.....16
2.2 Benefits of buffer zone.....18
2.3 Problems associated with buffer zone approach.....20
2.4 Proposed interventions..... 23

3.0 Research methods

3.1 Objectives 25
3.2 Site Selection 25
3.3 Analytical techniques.....28
3.4 Survey design and implementation.....32
3.5 Village and household sampling.....33
3.6 Limitations.....36

4.0 The Gonabis Buffer Zone: Biological profile

4.1 Ecosystem profile.....40
4.2 Ecosystem relation with key mammal species.....44
4.3 Wildlife movement patterns.....48
4.4 Density of key mammal species 51
4.5 Problematic species.....60
4.6 Endangered species 61

5.0 The Gonabis Buffer Zone: Socio-economic profile.....62

5.1 Socio-economic profile.....67
5.2 Attitude towards conservation.....70
5.3 Willingness to pay.....72
5.4 Validity.....74

6.0 Conclusion and suggestions.......76

References.....78

Foreword

by Rolf D. Baldus

The Selous Game Reserve is Africa's oldest (established in 1896) and largest (ca. 50,000 km^2) protected area. Due to its extraordinary global importance it was declared a World Heritage Site in 1982 by UNESCO. The Reserve went through many ups and downs, most notably the breakdown of management and the poaching crisis of the 1970ies and 80ies, reducing the rhinos from over 2,000 to not more than a hundred and elephants from over 100,000 to less than 30,000.

Since the late 1980ies management has been revitalized under the Selous Conservation Programme, a cooperation between the Tanzanian and German Governments. The Reserve stands financially on its own feet, as it is now allowed to retain half of its income from hunting and photographic tourism. The Tanzanian Government has vowed to honour this financial agreement even after the Selous Conservation Programme came to an end in 2003.

Under the same programme the Wildlife Division moved from the traditional concept of "Fortress Conservation" towards the involvement of rural communities in the management and sustainable utilization of wildlife on their land. Practical pilot projects started in the late 1980 around the Selous, and today this approach is embedded in the Wildlife Policy of Tanzania.

The oldest Pilot Wildlife Management Area (WMA) is the JUKUMU, an association of 22 villages which collectively manage the area of Gonabis. The benefits so far are limited to an annual concession fee of a tourist lodge within the WMA, a legal supply of bush meat on the basis of a quota, revenues from the sale of of this meat within the community, voluntary donations from hunting companies, the occasional sales of crocodile skins etc. The real money would come as soon as the WMA is fully registered and receives "wildlife user rights" under the law. Tendering the hunting and tourism rights in Gonabis could fetch 100,000 to 200,000 US$/year. The communities know this and their patience is running out.

Before the start of the WMA scheme, Gonabis was under imminent threat of losing its wildlife and biodiversity. Poaching for bushmeat and ivory was rampant, and isolated shifting cultivation took place along the Selous boundary. To protect these scattered fields elephants were shot along the Mgeta River. The benefits from all this exploitation were minimal, unsustainable and shared only by a few people.

Over years a dialogue was held with the communities, land use plans were developed in a participatory manner and finally a "Community Based Organisation", JUKUMU, was created. The objectives were two-fold:

- to allow long-term benefits from a sustainable use of natural resources in Gonabis, thereby reducing poverty and
- to conserve the natural resources and biodiversity of Gonabis

Management of the new scheme was placed in the hands of democratically elected committees, with practical control and law enforcement in the field becoming the responsibility of village game scouts in cooperation with the Selous' own security forces. The conservation activities, including the work carried out by village scouts, are financed mainly from JUKUMU's own income.

Gonabis has a tremendous biodiversity value, which has so far not been tapped. Although completely unreasearched as yet, we know from aerial surveys that it has the highest densities of the Niassa wildebeest (extinct in its southern range), zebras, giraffes and other large herbivores in the whole Selous ecosystem. The 250 km^2 hold a buffalo population of 3,000, a quickly growing elephant population with big tuskers showing up again, and endangered animals like wild dogs and the occasional cheetah. I myself have tracked rhino three km south of the Gonabis boundary in the Selous.

Being a temporary wetland Gonabis offers grazing until late in the dry season and it is therefore an indispensable extension for the wildlife of the Northern Sector of the Selous. This area, with its variety of vegetation, its lakes and channels, its mountain ranges and savannahs is scenically and in terms of wildlife numbers and variety the most attractive area in the whole Reserve. It has therefore been developed for tourism and has nine lodges offering high-class, low volume tourism. Gonabis is indispensable for the big mammals of the northern Selous, which migrate here regularly. Without Gonabis there

would be fewer wildebeests, buffaloes, zebras and impalas and fewer accompanying lions and wild dogs in the tourist sector of the Reserve.

However, Gonabis is endangered. In 1993 the managers of the Selous Game Reserve and the Selous Conservation Programme learned from a newspaper article that a large dam across the Ruvu River was being planned at Kidunda, about nine km east of Gonabis. The resulting lake would have covered most of Gonabis and parts of the Selous along its northern border. It would also have necessitated the eviction of around 16,000 to 20,000 people. Plans were well advanced, but after the Japanese Government, which was to be the financier of the dam, learned about the probable ecological consequences, the project was shelved, and Japan has no intentions to take them up again.

Since then the World Bank has been contacted and preparations for the dam have been going on for seven years now. The Bank has mixed experiences with such large dams and has become sensitive to ecological and social consequences, knowing that they are under critical international observation. The public in Tanzania, however, has been led to believe that agreement on the dam has been reached already and that it will be built. With such self-fulfilling political statements obviously facts shall be created irrespective of the results of a future Environmental Impact Analysis which the World Bank will apply as a normal procedure.

The Kidunda Dam is planned as a water reservoir for the supply of water to Dar es Salaam. The city certainly has a chronic undersupply of water. The reasons are an insufficient supply of water from the Ruvu, a defunct pipe system, an inefficient distribution and billing system and an equally inefficient and disorganized public water service provider. An effort to privatise the water services recently failed, mainly for political reasons. To increase the supply of water is therefore only one factor in a complex set of necessary actions. The question remains whether the Kidunda dam – apart from its clearly negative ecological and social consequences – is in any way a sensible option.

First of all, there have been other possible sources named, like the Rufiji and the Wami Rivers or a reservoir in the Ruvu close to Dar es Salaam. Also a dam in one of the narrow

gorges of the Uluguru Mountains and in particular deep ground-water etc are quoted as alternative options.

As a layman I have, secondly, never understood how this extremely flat pan, called Gonabis, without any elevations or low lying parts, can be suitable for a water reservoir at all. The name "Gonabis" in the local Kutu language means a kind of low – lying, flat place. The resulting lake will be extremely flat and consequently large. Evaporation and siltation will be very high. The Gonabis ecosystem is extremely dynamic, as I have observed over twenty years since I saw it for the first time in 1986. I have seen the Mgeta River changing its bed by up to 10 km north on two occasions in the 1990ies. We also observe that the water intake has become visibly less in the dry season recently. This might be a result of the ongoing destruction of the Uluguru Mountain vegetation, and the conservation of these mountains is a pre-condition for any effort to obtain water anywhere in the area.

Third, the supply route for water to Dar es Salaam is very long, and the water will therefore be costly.

Finally, the whole social impact of such a dam has not been considered yet. Apart from major resettlement rural communities would lose an area which they have managed as a kind of private nature reserve for nearly two decades now. They have never been involved in any kind of decision making as far as the dam is concerned, and the project was completely new to them when we informed them via JUKUMU. So far they are in total opposition.

Gonabis has never been subjected to any type of ecological research. The present paper was prepared by a postgraduate student as part of his participation in the internship programme which we run jointly with the Wildlife Division.
It was prepared in a time span of only three months and field research was hampered by rains and difficult access to Gonabis. Nevertheless the results might be useful as a first analysis of the ecological and socio-economic values of Gonabis – values which would be lost if a dam is built. I hope that more in-depth scientific studies will follow.

Acknowledgement

Many people have helped me in writing this research report. Without their help it would not have been possible for me to complete this research in a foreign country and within the stipulated time frame. My sincere gratitude is merited to all of them.

My special thanks to the Selous Project Manager, Mr. Benson Kibonde, for providing me with accommodation and logistical support during my stay in the Matambwe Sector of the Selous Game Reserve. Without his encouragement and support, this research work would have been extremely arduous.

I am beholden to Dr Rolf D. Baldus of GTZ Wildlife Programme in Tanzania and the Wildlife Division for giving me an opportunity to conduct the research in the Gonabis Buffer Zone as part of an "Internship Programme". My special gratitude is merited to him for advising me from time to time and for providing me with logistical support for conducting this research, not to mention an opportunity to stay in the African savannah for a month. Without his special consideration, it would not have been possible for me to have such an exposure to wildlife management in Tanzania, and eventually this research work.

Many people also offered me help during the fieldwork. Foremost amongst them is Mr. Twaha Semvua, the Community Wildlife Management Officer for JUKUMU, and the Village Game Scouts. My sincere gratitude is expressed to them for facilitating the group discussions and interviews at Bonye, Tulo and Magogoni villages, and for driving us through some of the most inaccessible parts of the Gonabis Buffer Zone.

My sincere thanks also to the staff members of the GTZ Wildlife Programme in Tanzania, Mr. Raymond Hall, Mr. David Kaggi and Mr. Philbert Ngoti for assistance. Charles Leonard worked parallel with me on the Gonabis Project as an intern. I am especially thankful to Charles for helping me translate the group discussions and interviews with the local community members. Likewise, my sincere gratitude is expressed to all the staff members of the Matambwe Sectors, Selous Game Reserve, for assisting me in conducting this research work.

Lastly, I am obliged to all the households who sincerely responded to the interview schedule and cooperated during the group discussions. Without their help this research would have been impossible to complete!

Executive summary

As many as 43 mammal species or 13 % of all mammal species found in Tanzania are considered as threatened by the IUCN. This number has increased from 33 (10 %) in 1996 to 43 (13 %) in 2000, in a mere span of four years. Of these, five species are considered as critically endangered, 11 as endangered and 27 as vulnerable. The main cause behind this situation is ascribed to conflict between people, wildlife and respective protected areas and failure of the institutions to reflect the actual value of these resources.

In the past few years, the Government of Tanzania has taken positive steps to ameliorate the interests of conservationists and local communities by introducing the concept of WMAs, a new category of protected area where people will have a right to manage wildlife. Though not as yet functional, the WMAs are likely to work as buffer zones with a dual function of biodiversity conservation and poverty alleviation.

Though holistic, the concept of buffer zone has failed worldwide in achieving its dual objective of combining biodiversity conservation with poverty alleviation. The main cause behind this failure has been the application of the buffer zone concept without regard to local environmental, social and economic conditions prevailing in the area where the buffer zone concept was applied. To make the buffer zone concept work, in this case the concept of WMA, there is a need to take the local situation into consideration.

This research work aims to have a better understanding of a region, which is most likely to become Tanzania's first WMA. The field work for this research was conducted for a month in Gonabis, the main hunting block of the JUKUMU pilot proposed WMA, located to the north of the Selous. During this research, a biological, social and economic profile of the area was prepared using some of the latest techniques and methods.

The study revealed that Gonabis is home to four main ecosystem types, namely, riparian forest, open woodland, dense woodland and scrub. These ecosystems harbor 21 important habitats, which are home to some of the most important flagship species found in

Tanzania, such as buffalo, wild dog, elephant, and lion. Most of these habitats are located on the banks of the river Mgeta along the border with the Selous Game Reserve. The others are mainly located along the seasonal river Mombwe and perennial river Ruvu, which also form a physical and political border between Gonabis and the surrounding villages. From a review of SRF surveys taken from time to time by the FZS and TWCM and distance sampling study, it was found that these habitats support a high density of mammals, namely, wildebeest, buffalo, impala, zebra, giraffe and reedbuck. For instance, in 1994 the SRF survey revealed that these habitats supported over 15,000 buffaloes and 14,000 wildebeest!

Besides having a high density of wildlife, Gonabis is also an important dispersal area for the wildlife found in the northern Sector of SGR. Each year, during the beginning of the dry season, thousands of wildebeest, zebra, buffaloes and impalas migrate from the reserve to these habitats. The cycle is repeated during the beginning of the wet season when the animals return back to the northern sector. Thus, Gonabis is crucial for maintaining a healthy population of wild animals found in the northern section of the world heritage Selous.

A socio-economic survey was also undertaken in the village zone having an immediate border with Gonabis. During this survey 40 households from three villages were interviewed, representing over 4 % of all households and population in the three villages and 2 % in the entire village zone comprising of eight villages. The study revealed that the average household size was 5.95, with the average age of the household head being 38.5 years. Most households reported as having primary education. The average land holding for the sample was 3.45 acres per household, and most were engaged in subsistence agriculture, almost one-third also worked as labor during the off-season. Livestock rearing is underdeveloped due to tsetse flies in the region. 20 % of the respondents were women.

Due to subsistence agriculture and underdeveloped livestock sector, the dependence of local communities on Gonabis is high, especially for bushmeat, which is the main source of animal protein. The local community also harvests raw materials for weaving baskets and house construction. Besides benefits, the locals also suffer from losses on account of movement of wildlife into the village zone. The pattern of these losses varies from ward

to ward. Overall, baboon, elephant, and vervet monkeys were found to be responsible for maximum agricultural damage, whereas leopard, lion and hyena were responsible for most livestock losses. In case of human mortality and morbidity, crocodiles were responsible for most killings, with the Magogoni village being the worst affected in the entire region.

During the attitude survey conducted in the village zone, the respondent households showed a positive attitude towards the conservation of wildlife in Gonabis. All households reported conservation of wildlife in Gonabis as important, for reasons ranging from the right of wildlife to live, to protecting wildlife for moral reasons and in return for the consumptive use benefits. In addition, most responded against the conversion of Gonabis to agricultural land and regarded Gonabis as a moderately important sector for government spending. Magogoni was the only village which was in favor of the conversion of Gonabis to agricultural land. All households were against the construction of dam on the river Ruvu, which will lead to complete submergence of Gonabis under water. The respondent households also accepted poaching as the main threat to the conservation of wildlife in Gonabis, followed by poor management of the area. These results were unexpected and may be the result of 17 years of cooperation with Wildlife Division and GTZ as part of the "Community Based Conservation" – Policy of Tanzania.

In their effort to conserve wildlife in return for the consumptive use benefits, each household was willing to provide on an average 10 labor days per year (median value), which has a cash value of TSh. 15,000. In addition, all respondents were most certain of their payment. On comparing the WTP with the socio-economic characteristics of the household, it was found that variables, such as education and gender of the respondents demonstrated a negative degree of correlation, while variables as age and land holding showed positive but weak degree of relation. This was because women respondents and those with higher education level were less willing to work as labor. In the case of land holding, households with higher land holding per capita were not as willing to provide labor work as households with low land holding per capita. There was a high degree of correlation between the attitude of the respondent households and the WTP. Consequently, WTP of the respondents was in consistence with the socio-economic behavior.

The study, however, was constrained by several limitations, of note being, mobility within Gonabis, time frame and proficiency in Swahili language. These had an evident impact on the distance sampling survey, which could not be accomplished with expected success on account of low number of observations and the flooding of Gonabis at the time of the main survey. In case of the CVM study, the estimation of Bid curves and Aggregation of WTP response was not undertaken on account of limited experience with the Calculus skills required for the same.

In order to reduce the text for the publication some literature reviews, lengthy explanations of the techniques applied and the appendices containing questionnaires, survey forms etc were removed from the original report. They are available from the author.

Despite limitations, the study made an interesting learning, which ranged from the ecological importance of Gonabis to socio-economic characteristics of local communities living on the fringe of Gonabis, their positive attitude and willingness to pay to conserve wildlife therein, not to mention a month long first hand experience of staying in the African Savannah. This study should be the first step towards a more comprehensive ecological assessment of this area, which is of high biodiversity value and at the same time an example of advanced positive involvement of the relevant communities in its management and conservation.

1.0 Introduction

Areas outside protected areas, variously designated as wildlife corridors, ecological networks, dispersal areas and breeding sites, and collectively referred to as buffer zones, provide a number of benefits. These benefits include maintenance of gene pool, environmental services, scientific research and education, eco-tourism, and people's cultural and spiritual traditions. These benefits have ecological, social and economic values, which contribute not only to the conservation of biodiversity but also to the well being of human population living on the fringe of such areas[1].

[1] The Wildlife Policy of Tanzania states that 'Wildlife is a natural resource of great biological, economical, environmental cleaning, climate ameliorating, water and soil conservation, and nutritional values that must be conserved. It can be used indefinitely if properly managed.' (MNRT, 1998:8)

In realisation of these benefits, attempts to integrate buffer zones with protected areas were made as early as 1970s through UNESCO's Man and Biosphere Program (MAB). The Convention on Biodiversity (CBD), which was unanimously adopted at the 1992 Earth Summit, also aimed at the integration of buffer zones with protected areas. The Summit emphasised that the effectiveness of protected area as a conservation strategy depends not on its existence as an ecological island but on its integration and management in a broader land use context and adequate participation by stakeholders, including local communities living on the fringe of the protected areas. In the late 1990s, the World Park Congress also endorsed buffer zone approach and recognised that ``the global system of protected area needs to comprise of an ecologically representative and coherent area of land.... chartered by interconnectivity with the landscape and existing socio-economic structures and institutions''.

Despite the fact that the buffer zone approach aimed at ecological buffering by extending the area of wild habitat in the protected area and social buffering by allowing for sustainable management of wildlife in providing products of use or cash value to local people, it failed in most cases to achieve its holistic objective of combining conservation with socio-economic development.

It failed mainly because of the lack of consensus among the conservationists on the definition and purpose of the buffer zone. While some conservationists called for ecological buffering as the principal aim, the others called for social buffering as the principal one. The result was that most studies conducted at the time when the buffer zone concept was being formulated ended up as being defocused. In the instance of lack of precise definition and defocused studies, a blue print model rather than an individually tailored one was applied in the creation of most buffer zones. This led to the ignorance of local environmental, social and economic conditions, which further contributed to the failure of the buffer zone approach. Consequently, the failure of the approach can be ascribed to three main causes: biological, social and economical.

Biologically, the buffer zone approach suffered a set back for local environmental conditions were not taken into consideration. The core and buffer zones were identified without adequate specifications on the flora and fauna found in the buffer zone. Likewise, the role of the buffer zone in relation to specific species, namely, crop raiding, livestock

raiding and species capable of causing human mortality and morbidity were not taken into consideration.

From the social perspective, the buffer zone approach failed due to short sightedness on the part of the policy makers to take into consideration the aspirations and attitude of the local community. In many cases, social construction of the society was not sufficiently analysed and their attitude towards proposed changes was completely ignored. Half-hearted attempts to encourage community participation, without due regard to the heterogeneous character of the community and vested interests of different community members also added to the failure of the approach. Lack of ownership rights and the use of top-down approach resulted in the creation of new forms of institutions to regulate the movement of local community in buffer zones, and in managing buffer zones like protected areas. Therefore, the ignorance of local social conditions resulted not only in the isolation of the community from the decision making process but also the imposition of conservation costs on them in the form of agricultural, livestock, and human loss, leading to what conservationists, such as Randall Kramer, define as 'colonialism of conservation', or the social causes of biodiversity loss.

Economically, the approach mainly failed due to the failure of the market systems in reflecting the actual value of benefits accruing from buffer zone, either due to complete absence of a market for the benefit, as in the case of most non-consumptive use benefits, or due to poor market design in capturing the actual value of the benefit. The failure of the government policy to correct these imperfections led to compounding of the problem. Therefore, the failure of the market and government systems in reflecting the actual value of benefits accruing from buffer zones led to a bias in cost-benefit analysis and hence in decision-making in the favour of anti-conservation activities, such as land conversion. This ultimately resulted in what conservationists define as the economic or the fundamental cause of biodiversity loss [Dixon and Sherman, 1991; Hanley and Spash, 1993; Pearce and Moran, 2004].

Consequently, the lack of consensus among conservationists on the definition of buffer zones, poor and unsystematic application of the concept without regard to the local biological, social, and economic conditions, resulted in the frequent failure of the buffer zone approach in combining biodiversity conservation with socio-economic development.

This led to the development of protected areas as ecological islands surrounded by human habitations, incomplete representation of habitat types, limited size for wide ranging species, loss of opportunities for conservation in human settled landscapes, and failure to provide for human residents in surrounding areas, resulting in what conservationists define as the biological and socio-economic causes of biodiversity loss.

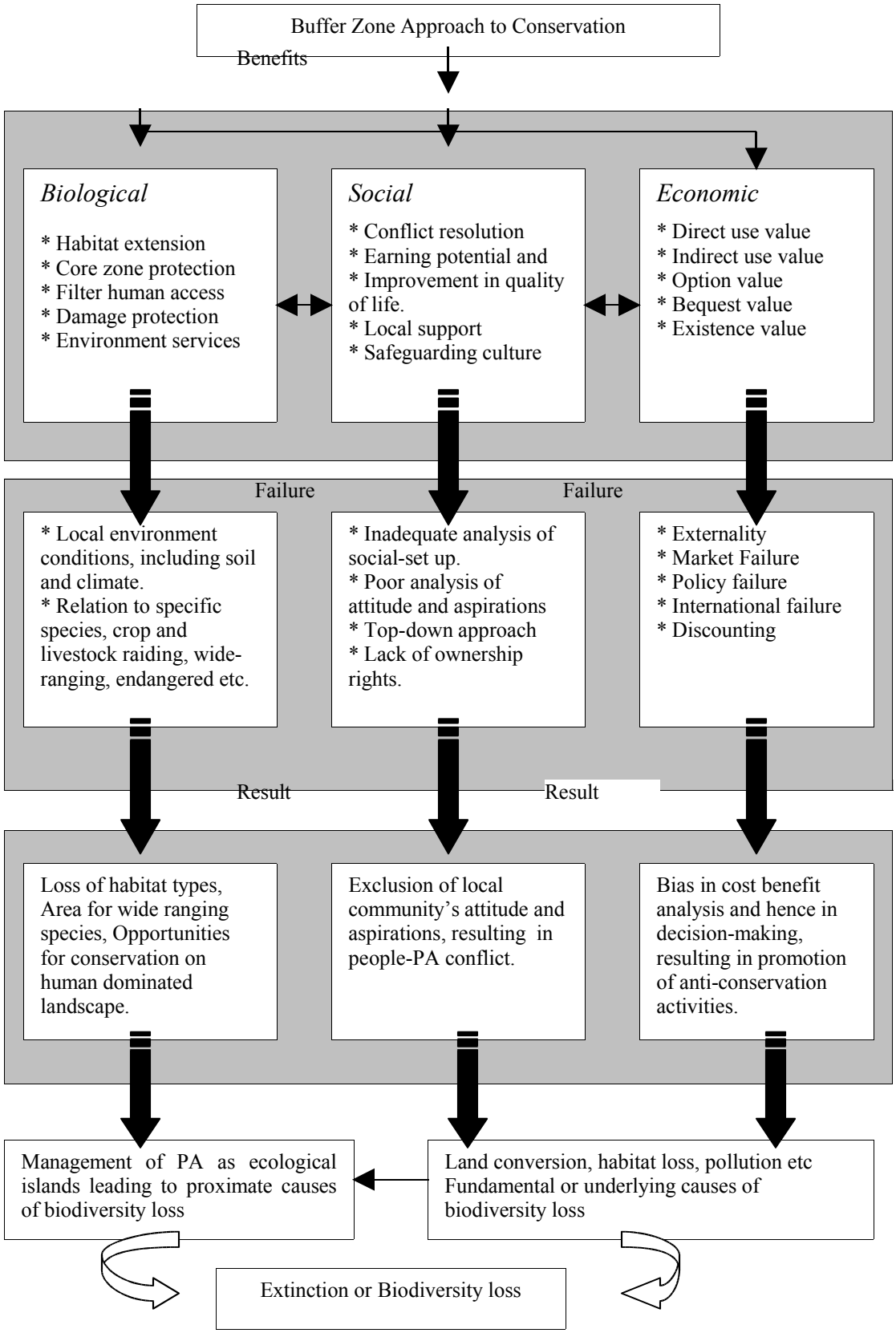
Therefore, if we are to achieve the dual objective of buffer zone approach, that is, biodiversity conservation and socio-economic development, there is a need to develop a thorough understanding of local conditions where the approach is likely to be applied, namely,

a) Biological or ecological conditions, such as, flora and fauna found in the buffer zone, role of buffer zone in relation to specific species, identification of important ecological habitats, etc.
b) Social conditions, such as, socio-economic profile of the local community residing on the fringe of the buffer zone, attitude of the local community towards the conservation of wildlife in the buffer zone, etc.

c) Economical aspects, such as, value of benefits local community derives from the buffer zone, their willingness to pay to conserve the buffer zone in return for these benefits, etc. [Ebregt and Greve, 2000]

This research work aims to prepare a biological (ecological), social, and economic profile of a functional buffer zone located to the north of the Selous Game Reserve in Tanzania. The buffer zone selected is Gonabis, a vast floodplain, which provides not only an important seasonal dispersal area for large herbivores in Selous, but also for the well being of local community residing in 22 villages surrounding the reserve on the north. Therefore, the focus of this research is to assist the local community, the Selous Game Reserve Management and GTZ, in having a better understanding of the ecological and socio-economic values of the areas as well as of the local conditions in order to avoid the main causes responsible for the frequent failure of the buffer zone approach.

Figure 1: Conceptual framework for the research



2.0 Literature review

This section deals with the review of literature collected from various sources, including published and unpublished documents available in libraries and on the Internet. It is divided into four main sub-sections, namely, definition and function of buffer zone, benefits of the buffer zone, problems associated with the buffer zone management and proposed interventions.

2.1 Definition and functions of buffer zone

Areas adjacent to protected areas, on which land use is partially restricted to give an added layer of protection to the protected areas itself while providing valued benefits to neighbouring rural communities' [Mc Kinnon et al, 1986].

Areas peripheral to a national park or equivalent reserve, where restrictions are placed upon resource use or special development measures are undertaken to enhance the conservation values of the area [Sayer, 1991].

An area in a reserve surrounding the central core zone, in which non-destructive human activities such as eco-tourism, traditional (low-intensity) agriculture, or extraction of renewable natural products, are permitted [Carroll, 1994 – taken from Martino, 2001].

From the above quotations, it is evident that though several definitions of buffer zone are consistent in referring to the dual function of the concept, they vary in their emphasis on the function of the buffer zone. While conservationists, such as Wells and Brandon, argue that the primary goal of buffer zones is to protect biodiversity and that the creation of benefits to local people is a secondary function, others, such as Carroll, maintain that the primary goal is to achieve socio-economic development for the communities living on the fringe of the zone. Consequently, it may be concluded that though the buffer zone definitions are focussed on the social impacts their goal is inevitably biological [Martino, 2001].

This dichotomy is further compounded when it comes to determining the success or failure of the buffer zone. Most analysis concerning the success or failure of the buffer zone concept do not focus on monitoring the ecological changes in the protected area but

on whether or not the human population living in the buffer zone is better off than before the establishment of the park [Martino, 2001]. In the words of Wild and Mutabi,
'*There is no doubt that resources should be available for them to use and, in fact, in some cases protected areas should provide for them. However, if buffer zones are designed to help achieve the conservation needs of the park, then the analyses of buffer zone results should be based on whether or not those conservation needs were accomplished.*' [Wild and Mutabi, 1997 - as quoted by Martino, 2001].

From the above discussion, it may be concluded that various definitions of the buffer zone concept vary in their emphasis on the principal role of the buffer zone and the way the success and failure of the concept is analysed.

Despite this variance, all definitions refer to the two fold objectives of the buffer zone: biodiversity conservation and socio-economic development. The buffer zone approach, therefore, has led to the evolution of an integrated approach, which considers protected areas as 'strategic spaces', to be effectively integrated with the wider landscape so as to achieve the overall objective of sustainable development. [Stolton and Dudley, 1999; Carey et al., 2000]. Given its dual objective, the establishment and maintenance of buffer zone is also regarded as a suitable strategy for resolving existing or potential conflicts [Nepal and Weber, 1994; Shyamsunder, 1996; Vandergeest, 1996; Heinen and Mehta, 2000].

As mentioned above, the buffer zones provide two main functions, which are in consistence with its dual objective of combining conservation with socio-economic development. These functions are:

- Extension buffering: extending the area of habitats protected in the protected area into the buffer zone, allowing larger breeding populations of plant and animal species.

- Socio-buffering: wildlife management is aimed primarily at providing products of use or cash value to local people as long as this does not conflict with the objective of the protected area itself.

[Mc Kinon et al, 1986; Paudel, 2002; Heinen and Mehta, 2000]

2.2 Benefits of buffer zone

Depending on the type of the buffer zone, natural conditions, and investments made, benefits accruing from buffer zones vary considerably and can be divided into three main categories: biological or ecological, social, and economic. These benefits are described below:

2.2.1 Ecological benefits

The ecological or biological benefits of buffer zones occur mainly from the territorial expansion of the protected area that keeps human impact further away. The territorial expansion is particularly important for the conservation of species with wide-ranging habitats and high mobility [Barzetti, 1993]. In addition, buffer zones also play an important role in increasing the population of rare and common species by soft edge effect [Shaffer, 1999]. They also provide breeding grounds and corridors for the migration of several wild species. Some of the ecological benefits accruing from buffer zones are listed below:

a. Filter or barrier against human access and undesirable use of core zone of the protected area.
b. Protecting core zone from invasion by exotic species of plants and animals.
c. Providing extra protection against storm damage, erosion, drought and other forms of damage.
d. Extension habitat and increasing the population of large wide-ranging species in the protected areas.
e. Enhancing environmental services provided by the reserve, such as watershed protection benefits, nutrient recycling and carbon sequestration.

[Barzetti, 1993; Shafe, 1999; Ebregt and Greve, 2000]

Given the nature of ecological benefits stemming from the establishment of buffer zones, it is essential that analysis of buffer zone results should take into consideration accomplishment of conservation or ecological needs [Martino, 2001].

2.2.2 Social benefits

As evident from the definition of the buffer zone, one of the main objectives for the creation of buffer zones is to provide socio-economic benefits to the local communities living on the fringe of the buffer zone. Consequently, buffer zones target conservation with recognition of the legitimate needs of the people. Given this situation, conservationists argue that there is no doubt that resources should be averted to people to use and in fact protected areas should provide them [Martino, 2001]. In general, buffer zones provide following social benefits:

a. Providing flexible mechanism for resolving conflicts between local communities and conservation.
b. Improving earning potential of the local communities.
c. Improving the quality of the environment of local people.
d. Building local and regional and local support for conservation program
e. Safeguarding traditional land rights and culture of local people.
f. Providing a reserve for plant and animal species for human use and for restoring species, population and ecological protection in degraded areas.

[Ebregt and Greve, 2000]

2.2.3 Economic benefits

The economic benefits accruing from the establishment of buffer zones have both ecological and social components covered in it. For instance the economic value accruing from the maintenance of watershed protection benefits is essentially ecological in nature, whereas the economic value accruing from consumptive use benefits is more community specific and hence has a social characteristics attached to it. The economic benefits mainly include:

a. Compensation to people for loss of access.
b. Increasing benefits from protected areas for direct users such as, income from tourism, resource permit fee from scientists, income of locals employed in the area.

c. Increasing value of protected areas from indirect use, such as protection of the buffer zone and watershed protection.
d. Increasing the value of protected areas for non-users, such as existence value and bequest value.
e. Increasing the value of direct use benefits such as consumptive use benefits

[Ebregt and Greve, 2000]

To sum up, buffer zones not only provide ecological protection by providing a barrier against human access and use of the core zone but also habitat extension for wide ranging species, not to mention protection against storm damage, fire and drought. On the other hand, buffer zones provide a number of socio-economic benefits to the human population living around the protected area, including opportunities for minimising the social causes of biodiversity loss by integrating the local communities with the protected area.

2.3. Problems associated with buffer zone approach

The buffer zone approach to integrating protected areas with the larger landscape has failed in many cases. In a study conducted by Martino of 11 buffer zones, it was found that only two were able to achieve the dual objective of conservation and socio-economic development [Martino, 2001]. This is mainly due to the lack of consensus among conservationists on the definition of buffer zone and poor understanding of the ecological, social and economic benefits accruing from the same.

Many authors argue that the real objective of the buffer zone is to protect the protected area from outside disturbance, however when it comes to determining the success and failure of buffer zone, the analysis does not focus on monitoring changes in wildlife, wild habitat, amount of stress on wildlife and increase or decrease in the number of key species. The analysis is particularly focussed on whether or not human population living on the fringe of the buffer zone is better off than before the establishment of the park [Martino, 2001].

Yet the others argue that many buffer zone projects aim not to improve livelihoods but to diffuse local opposition. There is no doubt that resources should be made available for the

communities, however, if buffer zones are designed to achieve conservation, the analysis should include whether or not conservation needs are established.

This double task has led to an ambiguous definition of buffer zone and hence evaluation of the benefits [Heinen and Mehta, 2000]. In the words of the World Bank, 'the popular idea that buffer zones provide a way for local people to generate benefits from the existence of a protected area must be carefully qualified'.

The confusion regarding the main objective of the creation of buffer zones resulted in many studies as being defocused. In such a case, a blue print model rather than an individual tailored one was applied to the creation of most buffer zones across the world, leading to the ignorance of the local environmental or ecological, social, and economical conditions prevailing in the area, ultimately resulting in most cases the failure of the buffer zone approach. These causes are discussed in detail below:

2.3.1 Ecological causes

The buffer zone approach failed on account of its failure to incorporate the following points into consideration:

a. Local environmental conditions were not sufficiently taken into account: core and buffer zones were identified without adequate information on biodiversity. This also includes interaction between species within ecosystems.
b. Soil and climatic conditions were not taken into account: species were introduced which were not adapted to local soil and climatic conditions resulting in the death of the introduced species, or the introduced species did so well so as to become pests, such as acacia and cassia species.
c. Role of buffer zone in relation to specific species not taken into account, for example crop raiding and wide ranging species: this is especially important in the case of wide ranging, crop and livestock raiding species, which need a special attention to prevent conflict. For instance plantation of crops such as sugarcane and tubers, which attract animals such as elephants, wild boar was like asking for trouble. This inevitably led to conflicts.
d. Division of ecosystem between core and buffer zone: resulted in the risk of disappearance of species due to specific measures taken in the creation of the buffer zone.

Therefore, usually the best approach is to include the whole area or ecosystem in the core zone.

e. Specifications on flora and fauna lacking: especially migrating, pests, crop raiding, endangered, endemic, vulnerable, sensitive areas and habitats, distribution of habitats and wildlife.

[Ebregt and Greve, 2000]

2.3.2 Social causes

a. Social construction of the society not sufficiently analysed: social structure and culture of people in the buffer zone was not fully integrated.

b. Attitude change in local community: creation of buffer zone requires an assessment of attitude of the local communities towards the proposed changes which are likely to occur due to the creation of the buffer zone. This is also important for change in attitude takes a long time.

c. Buffer zone objectives not in line with people's aspirations: should be agreed upon by local population, otherwise buffer zone is doomed to failure.

d. Half hearted community participation and implementation: community is not homogenous, clear and defined structure but conceals vested interests in terms of economic position, ethnic status, gender balance and age.

e. Lack of ownership rights.

f. Socio-economic values given too much emphasis: when buffer zones are established, people tend to overemphasize on socio-economic advantages and benefits of a buffer zone without strong factual justification, this may at a later stage lead to frustration among the stakeholders. A slow and steady start based on information from the field is important. It is also imperative to consider expectations of people before a buffer zone is established.

[Ebregt and Greve, 2000]

2.3.3 Economic causes

Most benefits accruing from the conservation of wildlife are not reflected by traditional markets. Wherever markets exist, they are poorly designed to capture the actual and the associated value of these benefits. This causes a clear bias in cost benefit analysis and hence decision making often in the favour of activities that disregard conservation. For instance, if land has economic value for agriculture, but no apparent economic value for

conservation, it is hardly surprising that we develop the land for agriculture and ignores its impact on the environment [McNeely etal, 1990, Pearce and Barbier, 2000].

The failure of the market systems to generate right signals about the benefits associated with the conservation of wildlife provides a rationale for the governments to intervene and provide further deterioration. Though government intervention intends to correct market failure through institutional reforms, taxation, regulation and incentives, many times such reforms are not in the interest of the environment and generate as much damage as is done by the lack of the government intervention. For instance, perverse subsidies offered by many countries on fertilisers and pesticides, which often leads to over-consumption of these chemicals and hence eutrophication of water bodies - more harm than good! [Pearce and Moran, 1994].

At times interventions aimed to correct market failure simply fail to work. For instance complete ban on logging and ivory trade. Such interventions stimulate the growth of illegal markets, which are both tough to monitor and expensive to control.

To sum up, policy failures include both ineffective interventions as environmental legislations and unintentional negative interventions as perverse subsidies. Together they highlight that government intervention is prone to be fallible, often dubbed by conservationists as 'government intervention failure' [Panayotou, 2002].

The conservation of wildlife yields local, national and international benefits. In the case of international benefits, while the audience benefiting from the same is global, the countries bearing the costs of conservation are few, and primarily concentrated in the tropical latitudes of the earth. The cost of conservation in these countries is either borne by the tax- payers or by the local communities living on the fringe of the protected areas. Many countries in the world, primarily located in the temperate regions, derive benefit from conservation of wildlife without having to pay for it. In economic sense, these countries constitute the free riders club.

If a country is rich in wildlife and does not receive any financial or other assistance to meet the costs associated with conservation and positive external benefits accruing from

it, it will have no incentive to look after thee resources, leading to what conservationists define as 'global intervention failure' [Pearce and Moran, 1994]

2.4 Proposed interventions

As evident from the above discussion, the causes for the frequent failure of the buffer zone approach to achieve its dual objective of combining biodiversity conservation with socio-economic development, has been mainly on account of poor and unsystematic application of the concept, without regard to the local biological, social, and economic conditions prevailing in the area where the concept is to be applied.

Consequently, if we are to achieve the dual objective of the buffer zone approach, we need to overcome the limitations by developing a better understanding of local biological or ecological, social and economic conditions of the area where the approach is likely to be applied [Ebregt and Greve, 2000].

In their analysis of the buffer zone approach, Ebregt and Greve suggest ecological, social and economic interventions. Conservation economists, such as Jeffery McNeely of IUCN, Dixon and Sherman of the World Bank and David Pearce of CSERGE, recommend that since most benefits accruing from the conservation of wildlife in the buffer zones is not traded in the market, valuation studies using non-market valuation techniques should be used to provide an estimate of the value of these benefits.

In combination with ecological and social studies, the valuation studies serve as a key to avoid the most fundamental and common causes of biodiversity loss. The valuation studies brings environmental values alongside economic benefits of the activity in question and makes it plausible to compare the benefits and costs of the environmental and other developmental activities, using the same monetary language which is used to justify developmental activities! [Mc Neely et al, 1990; Pearce and Moran, 1994; Pearce and Barbier, 2000; Dixon and Sherman, 2000].

In addition, the valuation studies can also be used as an input to measuring the environmentally adverse impacts of development projects, such as rail and dam construction, in wildlife conservation areas by using Environmental Impact Analysis.

3.0 Research methods

This chapter presents research objectives and analytical techniques used in meeting these objectives. The section also contains information on survey design and implementation, sampling methods used in the selection of the transect walks, villages, and households, and limitations of the research methodology.

3.1 Objectives

This research work intends to assess the status and importance of a buffer zone as a conservation area for both wildlife and local communities by taking into consideration its biological, social, and economic importance. Therefore its objectives are manifold:

1. To prepare a biodiversity profile of a buffer zone by taking into consideration ecosystem types found in the area, important habitats and their relation to key mammal species, namely, impala, buffalo, wildebeest, elephant, and zebra.
2. To provide preliminary estimates of the density of key mammal populations found in a buffer zone, namely impala, zebra, wildebeest, and buffaloes, their movement patterns and distribution.
3. To determine the attitude of the local communities residing in villages surrounding the buffer zone towards the conservation of wildlife in the buffer zone.
4. To determine the willingness to pay of the local communities living on the fringe of the buffer zone in return for the consumptive use benefits they derive from the buffer zone.
5. To prepare a socio-economic profile of the local communities living on the fringe of the buffer zone.

3.2 Site Selection

The field research was conducted in Gonabis buffer zone, which is a part of the larger Mgeta River Buffer Zone (MRBZ), located to the North of the Selous Game Reserve in

the Morogoro Rural District of Tanzania. The selection of the site was based on following considerations:

a) Importance: Gonabis lies to the north of the Selous Game Reserve. It is a vast floodplain, which acts as a seasonal dispersal area for wildlife, mainly, wildebeest, buffalo, zebra, impala, and elephant, found in the Northern Sector of the Selous Game Reserve. Consequently, it is important for the healthy management of wildlife in Selous ecosystem, which is not only a World Heritage Site but also renowned worldwide for its wildlife, particularly, elephants, wild dogs, and rhinos.

b) Status: Gonabis is a part of the larger MRBZ which is also a pilot proposed WMA under the tutelage of JUKUMU. Gonabis forms the main hunting block of this proposed WMA.

c) Biodiversity: Gonabis supports a high density of large herbivores, such as impala, wildebeest, zebra, giraffe, buffalo, elephants, and waterbuck. According to the SRF Surveys conducted from time to time (1987, 1994, 1998, 2002) by TWCM and Frankfurt Zoological Society (FZS), some areas in Gonabis have among the highest concentration of herbivores in the entire Selous Ecosystem. Apart from this, Gonabis also supports populations of endangered species as wild dog, and vulnerable species as elephant, lion, and cheetah.

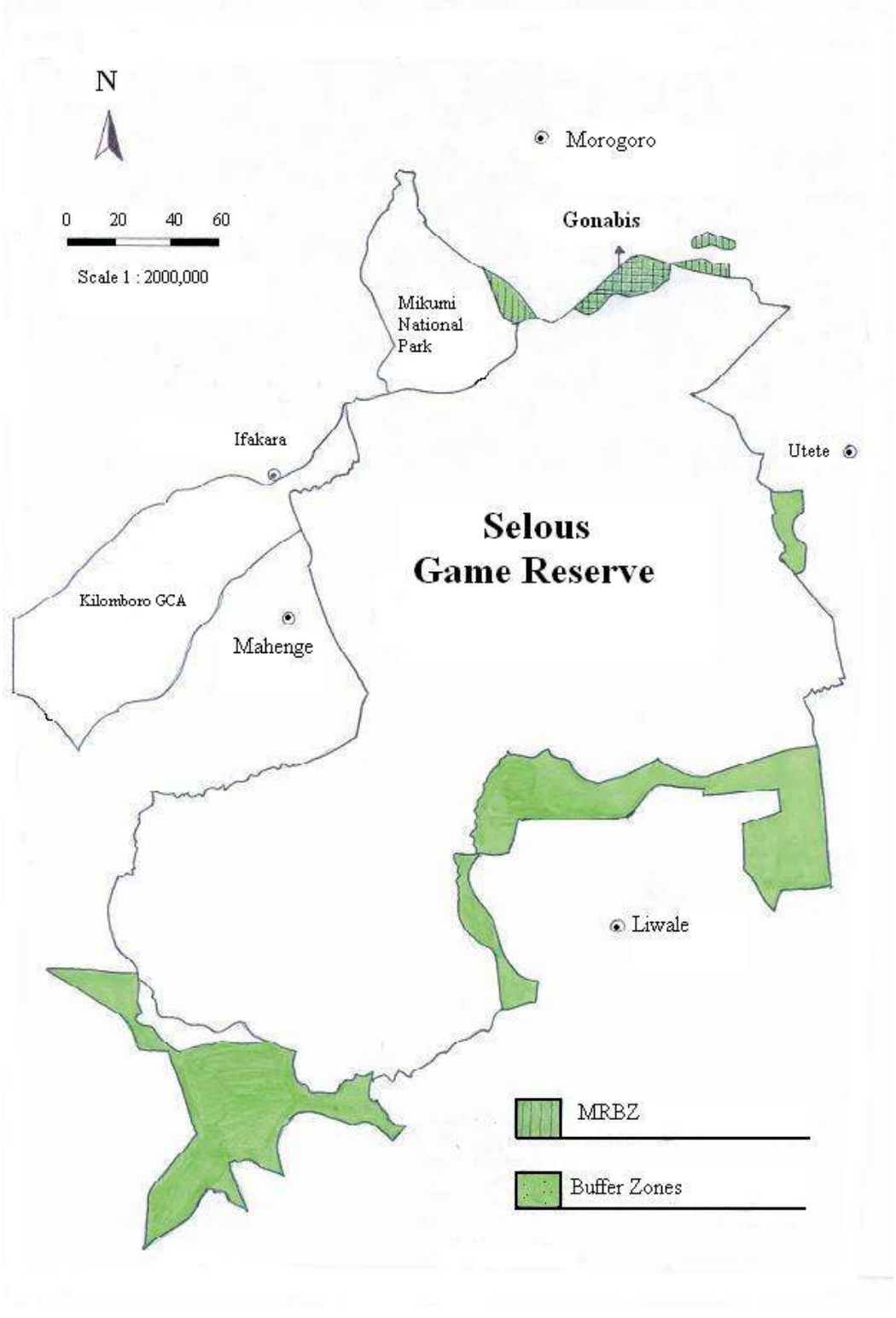
d) Anthropogenic pressure: Gonabis is a part of the larger MRBZ, which is bordered by 22 villages, of which eight directly border Gonabis on northeast and northwest. These eight villages support 2143 households and a total population of 13097. The density of population in these villages is high - 113 persons per sq km.

e) Socio-economic benefits: Gonabis provides consumptive use benefits to all the 22 villages that form the part of MRBZ or the JUKUMU Society, in the form of revenues from photographic tourism, tourist hunting, and bush meat. The annual quota of bush meat includes 200 wildebeest and 60 buffaloes. Besides this, the local communities also harvest non timber forest products from Gonabis, such as *Milala* for rope making.

f) Threats: Gonabis is threatened by poaching of wildlife by the local communities. However, a bigger threat is from the proposed dam on the River Ruvu at Kidunda Village, which will lead to near complete submergence of Gonabis under water.

g) Research works: Few systematic studies have been done on preparing the ecological, social, and economic profile of Gonabis. The focus of these studies is either mainly on Northern Selous, with Gonabis as a sub-component, or on the villages surrounding the Northern Sector of Selous.

Map 1: Location of Mgeta River Buffer Zone (MRBZ) and Gonabis.



3.3 Analytical techniques

To prepare the ecosystem profile of Gonabis, secondary sources were used. In addition, field observation and photographs were used to supplement the findings from the literature review. Focus group discussions together with participatory mapping and transect walks were used to identify the important wildlife habitats in Gonabis and their relation to key mammal species. A special emphasis was placed on buffaloes.

There exist several analytical techniques for estimating the density of wildlife populations, such as plot sampling, strip sampling, and distance sampling. The latter was used to estimate the density of three mammal species found in Gonabis: Impala, Wildebeest, and Zebra. To identify the movement patterns and distribution of key mammal species, focus group discussions with the Village Game Scouts and local communities were conducted. This was further substantiated through interviews with the JUKUMU Community Wildlife Officer and JUKUMU Chairperson, and sightings from the transect walks conducted in Gonabis.

To prepare a socio-economic profile of the local community living on the fringe of Gonabis, 40 households from three villages bordering Gonabis were interviewed. To determine the attitude of these households towards the conservation of wildlife in Gonabis, each respondent was asked seven questions, which are discussed in the main text. To estimate the willingness to pay of these households in return for the consumptive use benefits they derive from the conservation of wildlife in Gonabis, Contingent Valuation Method was used.

The most important techniques used in this research are described in short below. Details can be found in the literature quoted. The author has also a more detailed documentation of techniques used as an unpublished appendix.

3.3.1 Distance Sampling Method

Wildlife density of an area can be estimated by using several methods, such as plot sampling, strip sampling and distance sampling. For the purpose of this study, distance sampling was preferred over the other two methods. This is because, unlike in the other two methods, in distance sampling the size of the area may be unknown and many objects may not be detected for whatever reasons [Buckland et al, 2003: Chapter 1; Gurnell et al, 2001; Camphuysen et al, 2004; Barraclough, 2000].

Distance sampling is a method of estimating absolute density of biological populations based on accurate distance measurements of all objects near a point or a line. [Buckland et al, 1993]

Line transects were used to estimate the animal densities for three large mammal species: impala, zebra, and wildebeest. The lines were randomly placed across the study area covering a maximum distance of five kilometres. This was done so as to restrict the transect duration to a maximum of two hours to maintain full attentiveness of the observer [Emlen and Jong, 1981]. Transects were conducted during both morning and evening as animals have maximum activity during these periods. Three sets of measurements were taken for each of the three species listed above:

a. Radial distance of the cluster from the observer.
b. Angle of sighting from the transect line.
c. Size of the cluster

To estimate the radial distance of the cluster from the observer, laser range finder was used and attempts were made to measure the distance from the centre of the cluster. The angle of observation was measured through a simple hand held protractor, whereas the cluster size was determined using field binoculars. Finally, the data obtained was analysed using Distance Software 4.1.

3.3.2 Contingent Valuation Method

The consumptive use value of wild products harvested by locals from Gonabis can be estimated using existing Market Values and Contingent Valuation Method (CVM). For the purpose of this study CVM was be used. This is because in the villages surrounding Gonabis wild products are sold at a price lower than the market price, therefore the market values do not necessarily reflect the actual economic value of wild products [Baldus et al, 2003; Pearce; 1991; Pearce and Moran, 1994].

CVM is based on direct expressed preference approach. It has three main components: (a) Scenario: which presents the respondent with a clear description of the good he/she is asked to value, (b) Policy reform: that will be undertaken to ensure that the respondent receives the good, and (c) Payment vehicle: which represents the mechanism through

which respondents will be expected to pay or accept compensation for the reform [Dixon and Sherman, 1991: 38-39; Pearce, 1991: 258; McNeely and Munasinghe, 1994: 21].

Measure of Value

In the Contingent Valuation Method, the value of environmental good or service can be obtained by two measures: Willingness to Pay (WTP) and Willingness to Accept (WTA). While the former is based on the willingness of the respondent to pay to prevent the loss of environment good or service, the latter is based on the willingness of the respondent to accept compensation for the loss of the environment good or service.

For the purpose of this study WTP measure was preferred over WTA. This is because studies have revealed that WTA questions are difficult for the respondents to answer as many environmental goods and services are of doubtful and uncertain utility. WTA studies are also prone to a large number of protest responses and outliers since unlike WTP it is not constrained by the income of the respondent [Jakobsson and Dragun, 1996:127; Hanley and Spash, 1993: 63-64]

WTP Format

WTP can be measured by using several formats. These include: Bidding game, Closed ended, Open ended, and Payment card formats. Given the constraints imposed by language, time frame, and survey type, Payment Card format was used for the purpose of this study.

Payment Mechanism

Since the local communities inhabiting the villages having an immediate border with Gonabis comprise mainly of subsistence farmers, the number of days of labour work as against direct cash payments was considered as an appropriate payment mechanism. This was done so as to minimize the design bias in the CVM survey, for studies have revealed that controversial payment mechanisms can result in a large number of protest bids [Hanley and Spash, 1993: 60]. Also, alternative payment mechanisms, such as number of labour days, amount of grain, livestock etc, have been considered as appropriate payment mechanisms in subsistence and cashless economies [Kramer, 2001].

3.3.3 Focus group discussion and interviews

To identify most important habitats in Gonabis, their relation to key mammal populations found in Gonabis, wildlife movement and distribution patterns, focus group discussions were conducted with the JUKUMU Village Game Scouts (VGS) and local community members from three villages, namely, Bonye, Tulo and Magogoni. During these group discussion information was also collected on crop raiding and livestock raiding species and incidence of human mortality and morbidity accruing from wildlife.

Finally, personal interviews with the JUKUMU Community Wildlife Officer (CWO) and JUKUMU Chairperson were also conducted to substantiate the findings of the focus group discussion.

Table 3.1: Summary of analytical techniques/methods used

No	Purpose	Method/ Technique	Limitations
1.	Ecosystem types found in Gonabis.	Secondary sources: Rodgers, Transect walks, Photographs	Study based on secondary information on Selous as primary study on Gonabis is yet to be conducted.
2.	Ecosystem relation with key mammal species found in Gonabis.	Focus group discussion with village game scouts and local communities; Animal sightings during transect walks, Photographs.	Entire Gonabis could not be covered for detailed analysis.
3.	Density of key mammal populations in Gonabis.	Distance sampling: three sets of data – cluster size, radial distance, angle of observation. Secondary source: SRF	Animal sighting low for buffaloes, giraffe, waterbuck, zebra and wildebeest.
4.	Patterns of wildlife movement and distribution.	Focus group discussions with the village game scouts and local communities; Interviews with JUKUMU Chairperson and Community wildlife officer, Animal movements sighted during transects walks.	Only 25 % of Gonabis was covered for transects.
5.	Attitude of local communities towards conservation of wildlife in Gonabis	Focus group discussion and interview with local community members.	Bequest and option values not ascertained during the attitude survey.
6.	Willingness to pay of local communities for conservation of wildlife in Gonabis.	Interview with the local community members.	Estimation of bid curves and aggregation of response not undertaken.
7.	Socio-economic profile of the local communities.	Interview with the local community members.	Socio-economic profile restricted to 5 parameters: gender, age, household size, education, land holding, and occupation.

Source: Primary survey, 2005.

3.4 Survey design and implementation

The process of survey design and implementation involved three main stages: Literature review, Pilot study, and Main survey. During the first stage, information from the literature review was used to formulate the guidelines for the preparation of the ecological profile[2], density of key mammal populations, attitude towards wildlife conservation, and CVM study. This was followed by a pilot study, whereby the guidelines for distance sampling and CVM study were tested, so as to remove inconsistencies, if any, prior to the launch of the main survey. During the third and the final stage, the main survey was administered. The details are given below:

3.4.1 Literature review: During this phase, firstly, a review of literature on ecological monitoring was undertaken. The guidelines proposed especially by Ebregt and Greve, Sayer, Forero et al, and Gwynne and Croze, were used to identify key parameters required for preparing a comprehensive ecological profile of Gonabis.

3.4.2 Pilot study: During this phase, three transect walks, covering a total distance of 10 km, were conducted in the Northern Sector of Selous.

During the transect walks three sets of data (radial distance, cluster size, and angle of observation) were collected for three species, namely, impala, wildebeest, and zebra[3]. The data obtained were used to estimate the encounter rate (n0/L0) for each species, average cluster size for each species, and the total transect length to be covered in Gonabis. As a measure of precision, the coefficient of variation was taken as 30 % in the case of wildebeest and zebra, and 10 % in the case of impala.

Based on the experience of the pilot study, the length of each transect walk to be undertaken in Gonabis was restricted to 5 km.

For the contingent valuation study, a pilot survey was undertaken in Bonye village. During this survey five households were interviewed to check for the respondent's

[2] Ecological profile here includes important wildlife habitats found in Gonabis, their relation to key mammal species, and wildlife movement and distribution patterns.
[3] Originally buffalo and giraffe were also included in the survey, however, the number of observation was low in case of both the species, therefore they were not included for data analysis and hence subsequent studies.

reaction towards the attitude survey and the payment vehicle, in this case, the number of labour days.

3.4.3 Main survey: The main survey was administered in two phases. During the first phase, the main survey was administered in the Gonabis buffer zone, whereby data for ecological profile and the wildlife density were collected. During the second phase, the main survey was administered in three villages surrounding the buffer zone, whereby, the attitude and the CVM studies were conducted.

For estimating the density of impala, wildebeest and zebra, five line transect walks were undertaken. The line transects routes were fed into the GPS so as keep minimum deviations from the line. The transect lines were placed in such a way so as to cover all the main ecosystem habitats found in Gonabis. However, due to seasonal inaccessibility, the river Mombwe region could not be explored.

For the attitude and CVM study, the main survey comprised of face-to-face interviews with 40 households in three villages. The village selection and household selection criteria are discussed in the next section.

3.5 Village and household sampling

The contingent valuation survey was conducted in three villages surrounding Gonabis and 40 households from these villages were interviewed. The criteria for the selection of the villages and the households are discussed in individual sections given below.

3.5.1 Village sampling

In total, there are 22 villages in this zone, which derive benefits from this buffer zone under the association of JUKUMU Society.

For the purpose of this research work, only eight of the 22 villages, which form an immediate border with Gonabis, were taken into consideration. Of these, five villages are located on northwest and three on the northeast side. These villages include, Bonye, Mbwade, Kongwa, Tulo, and Magogoni on the northwest, and Bwila Juu, Bwila Chini, and Kibulumo on the northeast. Since demographic and land use data for Kibulumo

village was not available, the effective number of villages considered for village level sampling was reduced to seven.

Of the seven villages forming an immediate border with Gonabis, Bonye, Tulo and Magogoni were finally selected. A multi-fold criterion was used for the selection of these villages. Firstly, all the seven villages were stratified on the basis of their location in a particular ward and area per capita contribution to the proposed WMA. The reason for the selection of these two criteria is given below:

1. Location of a village in a particular ward: Villages surrounding Gonabis can be divided into three wards, namely, Selembala on the east, Mvuha on the north, and Bwakira on the west. The villages were selected in such a way so as to represent each ward. This is because the socio-economic and consumptive use patterns may vary from one ward to another. Also different wards may have different levels of access, attitude and interface with Gonabis. For instance, villages in one ward may have proximity to grasslands in Gonabis and others to riparian forest or woodlands.

2. Land use pattern in a village: The villages exhibit diversity in their land use patterns. For instance, in the case of Magogoni, the land area devoted to the proposed WMA is as high as almost 95 %, whereas in the case of Bwira Chini it is only 33 %. Likewise, only three of the seven villages, Tulo, Magogoni, and Kongwa, have land under grassland, the other four villages have no land under grassland. It is likely that the presence and absence of land use under woodland, grassland, agriculture, and WMA, does influence the dependence of the local communities on the resources in the Gonabis buffer zone. In this case, land devoted to the proposed WMA was taken as the principal consideration because it was believed that a higher proportion of land devoted to the proposed WMA leads to a higher expectation in return for the benefits from the Gonabis buffer zone.

Table 3.2: Profile of the villages surrounding the Gonabis Buffer Zone

Village	Ward	HH's	Pop	WMA	WMA/C	Wd/ C	GL %	AFS
Bonye	Bwakira	585	3509	78.57	2.24	0.28	0.00	6.00
Mbwade	Bwakira	384	2685	77.19	1.92	0.24	0.00	6.99
Kongwa	Mvuha	231	1153	75.62	5.78	0.71	3.91	4.99
Tulo	Mvuha	205	1023	80.72	4.24	0.33	5.66	4.99
Magogoni	Selembala	148	865	94.59	15.99	0.28	1.77	5.98
Bwira Chini	Selembala	370	2961	32.52	0.36	0.21	0.00	8.00
Bwira Juu	Selembala	220	881	56.01	2.45	0.42	0.00	4.00

Source: Selous Management Plan, 1998.

Notes: WMA = % of village land; WMA/C = WMA land per capita; Wd/C = Woodland per capita; GL = Grassland; AFS = Average Family Size

Based on the information from Table 3.2, the following matrix was prepared:

Table 3.3: Matrix based on ward location and land use devoted to the proposed WMA.

WMA/C / Ward	High	Medium	Low
Bwakira			Mbwade and **Bonye**
Mvuha	Kongwa	**Tulo**	
Selembala	**Magogoni**	Bwira Juu	Bwila Chini

Source: Primary Survey, 2005.

From this matrix, three villages were selected so as to represent three different wards and different levels of land use devoted to the proposed WMA. As evident from the Matrix, a choice had to be made between Bonye and Mbwade village. Even though the land use patterns were similar in both the villages, Bonye was selected because its socio-economic characteristics were more representative of the entire zone.

Two other factors were also used for village level sampling. These are described below:

3. Social composition of the village: Of the seven villages forming an immediate border with Gonabis, only Bonye and Mbwade have Masaai settlements. Therefore, it was considered important to select one of these villages so as to reflect the attitude and interests of the minority communities in the region.

4. People-Buffer Zone Interface: The seven villages interact with the buffer zone in different ways. For instance, during the reconnaissance survey, it was found that Magogoni village suffers from a high incidence of human morbidity and mortality from the wildlife found in Gonabis, whereas Bonye suffers from heavy crop and livestock damage. This interface was considered as important in reflecting the attitude of the local community towards the conservation of wildlife in Gonabis.

Thus stratified random and cluster sampling were used to select the three villages.

3.5.2 Household sampling

40 households from three villages were surveyed for this research. Criteria for selection were demographic, social, economic and socio-economic character of each household.

Thus, stratified random sampling was used to select the households from the three villages.

Table 3.4: Household distribution and representation from each village

Village	Total households	Sampled households	Percentage (%)
Bonye	585	13	2.22
Tulo	205	20	9.75
Magogoni	148	7	4.72
Total	938	40	4.23

Source: Primary survey, 2005 and GTZ, 2001.

As evident from the above table, the sample size of 40 households represents slightly over four percent of the total households in the sampled villages. However, the household representation from each village was not the same. While almost 10 percent of the total households were surveyed in Tulo, only five percent were surveyed in Magogoni, and still lower, two percent in Bonye.

Table 3.5: Profile of the surveyed households

Parameter	Sampled households	Sampled villages	Entire Zone	Representation %
Households	40	938	1923	(4.23) (1.86)
Population	238	5417	12,216	(4.39) (1.81)

Source: Primary survey, 2005 and GTZ, 2003.
Note: Entire zone here refers to the seven villages having an immediate border with Gonabis.

As evident from Table 3.6, the sample size represents slightly over four percent of the total households in three sampled villages, and almost two percent of the total households in seven villages having an immediate border with Gonabis. Similar results are obtained when population of the surveyed households is taken into consideration.

3.6 Limitations

Though attempts were made to make the study as comprehensive as possible, the study does suffer from several limitations:

a) The biological profile of Gonabis is based on the study of a few large herbivores only. Other herbivores, primates, and carnivores were not taken into consideration either due to difficulty in sighting, as in the case of lions, hyenas, and sable antelope or due to super abundance, as in the case of baboons and warthogs. This is because as Ebregt and Greve point out, it is not important to consider all species, but only the most important species and habitat types [Ebregt and Greve, 2000].

b) Wildlife density estimates were confined to only three mammals, wildebeest, impalas, and Zebras. Density for other key mammal species, namely, buffalo, waterbuck, giraffe, and elephants, could not be ascertained due to limited number of observations. Even in the case of wildebeest and zebra, the number of observation was low.

c) Owing to the limited time frame, only eight villages forming an immediate border with Gonabis were taken into consideration. The remaining 12 villages, which also derive benefits from Gonabis, were not taken into consideration.

d) In the case of economic values, only consumptive use and existence values were taken into consideration, however, the main emphasis was still on the former and the latter was only included in the attitude survey.

e) Land holding was taken as an indicator of wealth and income. Consequently, income estimates for each household interviewed for the CVM study was not undertaken. This is because former studies have revealed that land holding indeed is the indicator of wealth in the area of study.

f) In case of the CVM Study, the estimation of bid curves and aggregation of the WTP response was not undertaken on account of limited experience with econometric skills required for the same.

4.0 The Gonabis Buffer Zone: Biological profile

The Gonabis Buffer Zone lies to the north of the Selous Game Reserve at a distance of about 100 km from Morogoro town. It is a part of the larger Mgeta River Buffer Zone (MRBZ), which extends from Mkulazi Forest Reserve in the east to Mikumi National

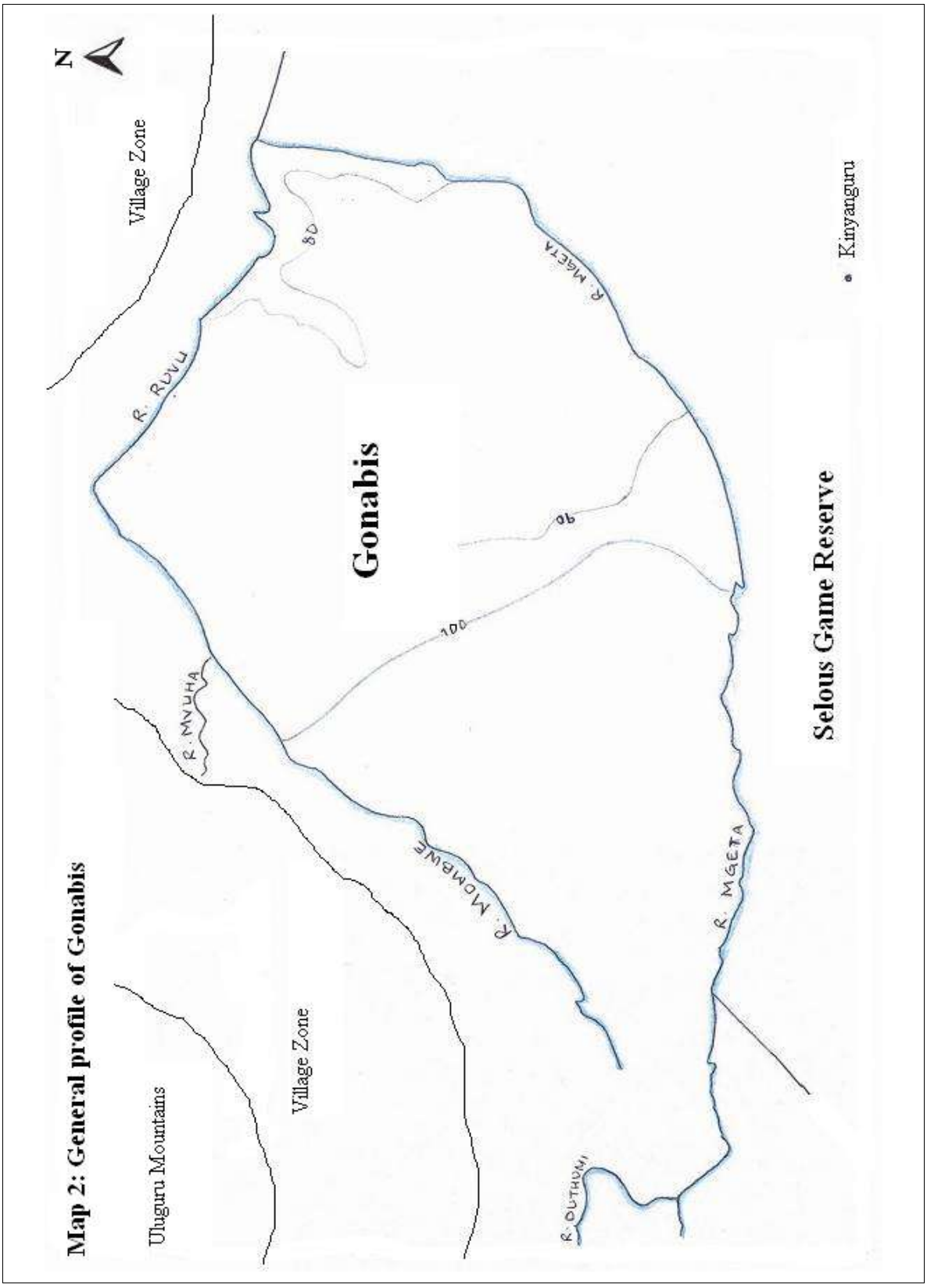
Park in the west. The Gonabis buffer zone actually forms the main hunting block of the MRBZ - popularly known as "JUKUMU proposed WMA".

Gonabis covers about 250 sq km of vast alluvial plain, bounded by river Ruvu on the North, river Mgeta on the south and east, and river Mombwe on the west. Of these, while Ruvu and Mgeta are perennial, Mombwe is seasonal and acquires a flow only during the wet season. On an average the area receives 100 cm of rainfall in a year, most of it from March to May. During the wet season, Gonabis turns into a seasonal wetland and the rainwater starts receding in the month of June.

Topographically, Gonabis is a flat low-lying area with almost insignificant slope, altitude variation being only 20 meters in 25 km. The 100 m contour roughly divides Gonabis into two sections. The eastern or the lower section lies between 80-100 meters, while the western or the upper section lies at 100 metres above the mean sea level. Though, open woodland covers most of Gonabis, with smaller areas of scrub, dense woodland and riparian forest, the vegetation cover is homogenous in both the lower and upper section.

The woodlands of Gonabis support a high density of ungulates, namely Niassa wildebeest, elephant, buffalo, zebra, giraffe, impala, common waterbuck, Bohor reedbuck, red duiker and a few sable antelope, to name some. The Nothern Selous rhino range extends up to the Mgeta river and rhino has been tracked (R.D. Baldus, pers. comm.) as close as 3 km south of Gonabis. The area also supports population of large carnivores, such as hyena, lion, leopard, wild dog (common), and cheetah. Cheetah is extremely rare in the whole Selous ecosystem, but has been photographed near Kinyanguru (R.D. Baldus, pers. comm.), about 6 km south of Gonabis. Villagers also reported sightings during interviews several of the occurring species are endangered or vulnerable. The main threat to wildlife is from poaching by local communities living in nearby villages. A complete list of key mammal species is as follows: Elephant, giraffe, zebra, hippo, buffalo, eland, hartebeest, waterbuck, sable antelope, reedbuck, impala, bushbuck, duiker, dikdik, bushpig, warthog, aardvark, lion, leopard, cheetah, caracal, serval, civet, ratel, hyena, wild dog, crocodile, yellow baboon, vervet monkey, black and white colobus, blue monkey, porcupine.

Gonabis forms a buffer zone between the Northern Sector or the Tourism Zone of the SGR and eight villages lying to its north and west of the river Mombwe. It provides many benefits to the residents of the 22 villages, which form a border with the MRBZ, namely, revenue share from photographic and hunting tourism, bush meat, and the non timber forest products.

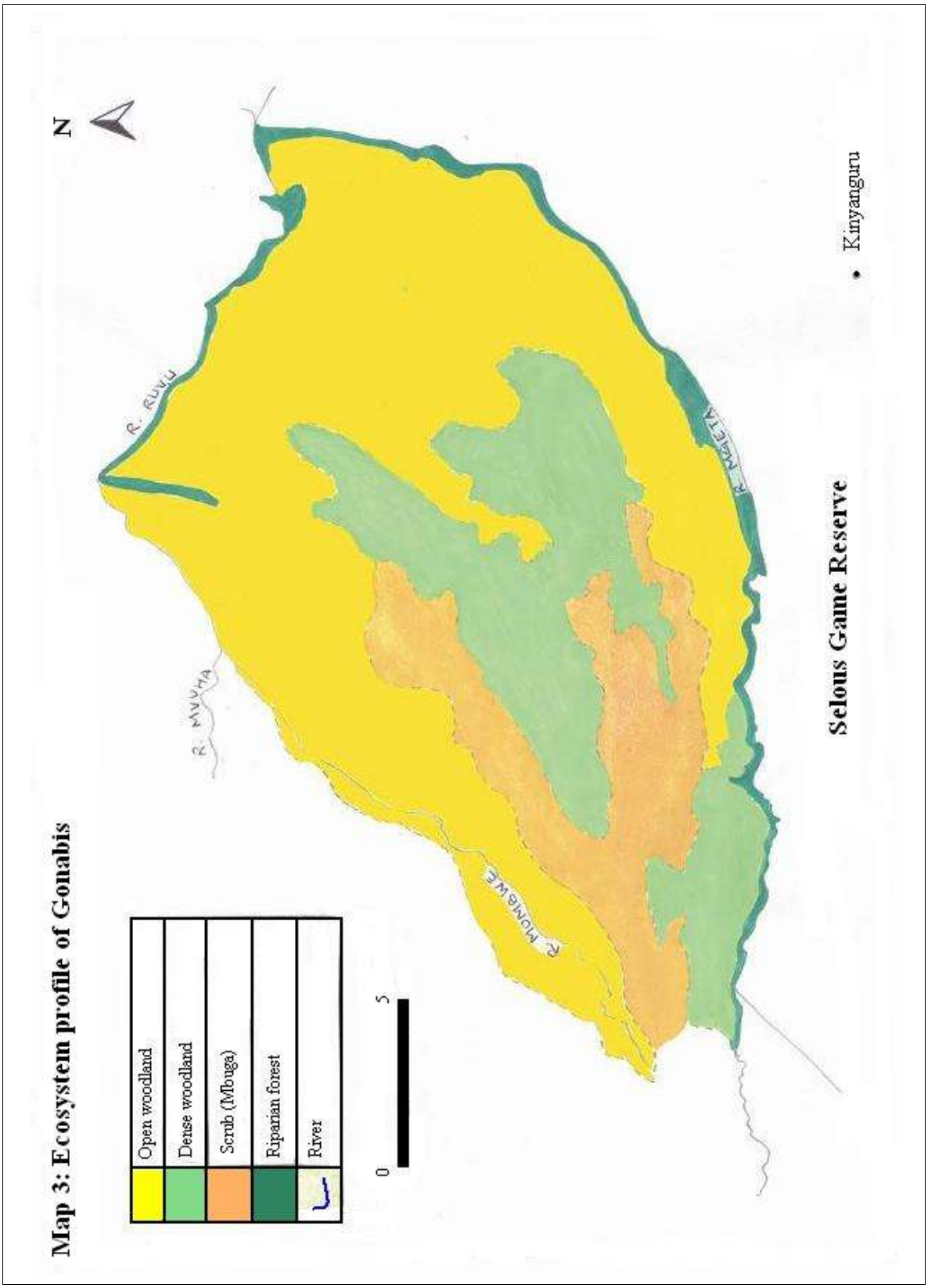


4.1 Ecosystem Profile

The Gonabis buffer zone is a mosaic of ecosystems, ranging from riparian forest and dense woodland to open woodland and *mbuga* (scrub).

According to a study conducted by Rodgers, the Selous ecosystem, which comprises of Gonabis, falls into the south-east Tanzania block of dry woodland or Miombo, which can be defined as: ‘’A deciduous unarmed woodland occurring in the unimodal rainfall areas of East and Central Africa….and characterised by Caesalpiniaceous trees, especially species of Brachystegia and Julbernardia… The ground cover varies from a dense coarse grass cover to a sparse cover of herbs and small grasses. The shrub layer is variable in density and species composition, often dominated by Diplorhyncus condylocarpon and species of Combretum. ’’ [Rodgers, 1970; 3.2].

Based on these physiognomic divisions, the Gonabis buffer zone can be divided into three main ecosystem types: Riparian forest, Woodland, and Grassland. Of these, the woodland can be divided into close and open woodland. These ecosystems are described below:



a. Riparian forest: defined as closed vegetation type dominated by shrubs and trees of less than eight meters, with the absence of sparse ground cover. This ecosystem type covers the smallest area of all ecosystem types found in Gonabis. It is found all along the river

courses of Mgeta and Ruvu. The dominant tree species found in this zone include *Afzelia quanzensis, Sterculia appendiculata*, and *Acacia xanthophloea* on edges of the forest, *Trichilia emetica* throughout the riverine forests, *Pterocarpus tinctoriu (*a timber tree), *Berchemia discolor, Lampothramnus zanguebaricum, Terminalia sambesiaca, Sorindeia - madagascariensis, Manilkara mochisia* with occasional *Diospyros cornii, Xylopia parvifolia, Piliostigma thonningii* and *Lonchocarpus capassa*. The dominant shrubs found in this system include *Lampothramnus zanguebaricum, Suregada zanzibariensis, Erythroxylum emarginatum, Polysphaeria spp.* and *Cola elevata*. [See picture 1 below].

Picture 1: Riparian ecosystem type along the river Mgeta.

b. Woodland: It is a true Miombo coverage dominated with deciduous trees from 8-25m tall, whose crowns are not touching; canopy cover being from 20 to 80 %. Based on the canopy cover, this ecosystem type can be divided into two main types: open and dense woodland. Together, the woodland covers more than 70 % of Gonabis' area. While the dense woodland in mainly concentrated in the center of Gonabis, the open woodland surrounds the dense woodland on the east, north and south and mostly covers the eastern and northern areas of Gonabis. The latter is also the most prominent ecosystem sub-types found in Gonabis and harbours some of the most important habitat areas for wildlife.

Both dense and open woodland ecosystem types are multi-layered and comprise of tree cover, shrubs and grassland The dominant species found in this ecosystem type include

Brachystegia bussei, Brachystegia longifolia, Julbernardia globiflora, Acaciazanzibarica and *Terminalia spinosa, Pseudolachynostylis maprouneifolia, Albizia harveyi, Pterocarpus angolensis, Acacia nigrescens, Pteleopsis myrtifolia, Combretum collinum, Diospyros kirkii, Pterocarpus tinctorius, Lonchocarpus bussei* and *Millettia stuhlmannii. Brachystegia microphylla.* Dominant shrubs include *Annona senegalensis, Rourea orientale, Catunaregan spinosa, Diplorrhynchus condylocarpon* and *Ximenia caffra* var. *natalensis*. The picture of both dense and open woodland is given below:

Picture 2: Dense woodland in Gonabis

Picture 3: Open woodland in Gonabis

c. Grassland: a completely open type with no or very few woody elements. It is mostly found in the western part of Gonabis, between river Mombwe and river Mgeta. The predominant species of tall perennial grass found in this ecosystem include *Hyparrhenia rufa, Heteropogon contortus, Themeda triandra*. It may also contain a high percentage of shrubs and herbs in the ground floor. The pictures of grassland with and without woody elements are given below:

Picture 4: Grassland without woody elements

Picture 5: Grassland with woody elements

4.2 Ecosystem relation with key mammal species

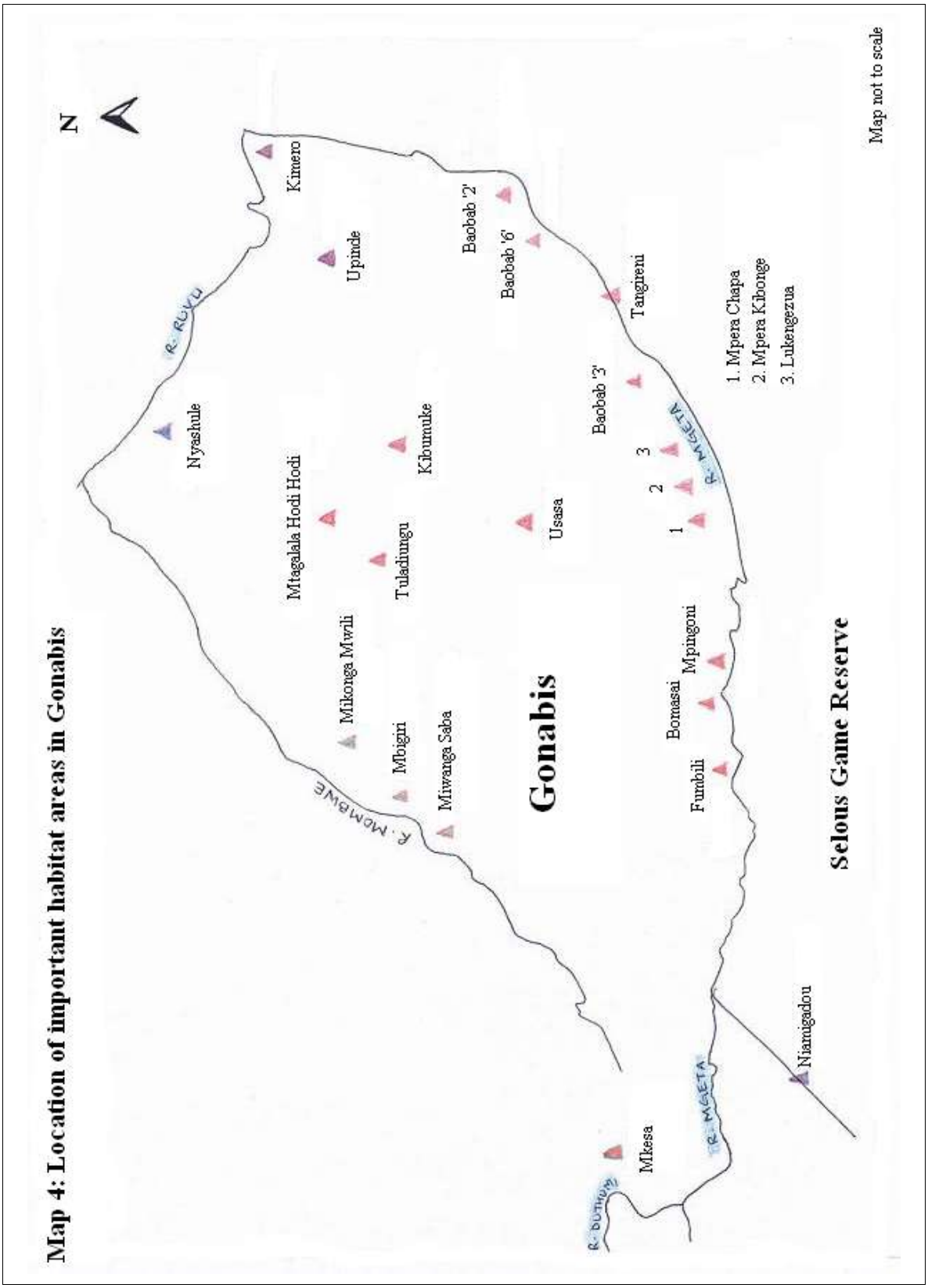
The ecosystem diversity in Gonabis has led to the presence of a wide variety of mammals in the region. Mammals in Gonabis are not equally spread out across all ecosystem types but are concentrated in a few areas, which also constitute the most important wildlife habitats in Gonabis. Though these areas are distributed across the region, they are mainly concentrated along the river courses of Mgeta and Mombwe.

From the group discussion and interviews conducted with JUKUMU officials and residents 21 such important wildlife areas were identified and mapped. Since most of these habitat are found along the three main river courses surrounding Gonabis, they can be categorised into four main categories: Mombwe, Mgeta, Ruvu and others. The distribution of these habitats is given in the following table and map.

Table No 4.1: Important habitats and their relation to flagship species

Habitat area	Habitat name	Flagship species	Ecosystem types	Total
Mombwe	Mikonga mwili, Mkesa, Miwanga saba, Mbigiri	Buffalo, Eland	Open woodland	4
Mgeta	Bomasai, Mpera chapa, Lukengezua, Fumbili, Tangireni, Baobab 2, Baobab 3, Baobab 6, Mpera kibonge, Upinde	Elephant, Buffalo, Lion, Wild dogs	Riparian, Open Woodland, Grassland	10
Ruvu	Kimero, Nyashule, Kibumuke	Lion, Sable, Hartebeest	Riparian and Open woodland	3
Others	Usasa, Mtagalala hodi hodi, Tuladiungu, Niamigadou	Buffalo, Hartebeest	Dense and Open woodland	4

Source: Primary survey, 2005.



The important wildlife habitats are concentrated mainly on the eastern bank of the river. Unlike Mgeta and Ruvu, which have riparian forest belt running continuously along their

banks, Mombwe has open woodland with tall grasses on either side of its banks. This is because Mombwe is a seasonal river, which runs from April to September. Even though the river remains dry from October to March, its course is left behind with several water puddles, sufficient enough to support wildlife populations, especially that of buffaloes.

The open woodlands of Mombwe support four to five resident herds of buffalo, which are found both during the wet and dry season, the average size of the herd being more than 100 individuals. Thus, it may be concluded that the river supports at any given time in a year over 500 buffaloes.

The buffalo population is not equally distributed along the river but is confined to four important areas, namely, Mbigiri, Mikonga mwili, Miwanga saba and Mkesa. Of these, only Mkesa is located on the western banks of the river. During the dry season, the herds move to the Mkesa area because the latter lies in proximity of river Duthumi, which is a perennial river and provides water for the herds during the dry season.

Besides buffaloes, the open woodlands of Mombwe also support eland, waterbuck, hartebeest, zebra, wildebeest and elephant population. Elephants are found along Mombwe only during the dry season. Wild dogs sightings have also been reported from this zone including packs of over twenty animals.

4.2.2 Mgeta Habitats

Of the 21 important wildlife habitats in Gonabis, nearly half are concentrated along the river Mgeta. The Mgeta habitats support a wide variety of ecosystems, ranging from riparian to open woodland and grassland. Due to this wide variety of habitats, it also supports a wide range of mammals. Mgeta habitats are particularly important for elephants, which are chiefly found in areas, such as Mpera chapa and Lukengezua. These areas are rich in Borassus trees, which attract elephants especially during the month of April, when the fruiting season is at its peak. However, elephant concentration is high during the dry season and declines during the wet season when they move south into the reserve. The elephant population in the Mgeta habitats is expected to vary from 100 to 300 individuals.

Picture 6: Borassus trees in Mpera chapa area.

Picture 7: Borassus fruits during March

Besides elephants, Mgeta habitats constitute the second most crucial habitat for buffalo population in Gonabis. Buffaloes are particularly found in areas, such as Baobab two, Baboba three, and Baobab six, all located along the boundary with the Selous Game Reserve. It is estimated that there are four herds in the area, with one herd size averaging above 200 individuals, and the others varying from 100-150 individuals. These buffalo herds are however migratory and migrate seasonally from the SGR to Gonabis and vice versa via Fumbili, Lukengezua, Bomasai, and Niamigadou areas. Thus, it may be concluded that just like the river Mombwe habitats, Mgeta habitats also support over 500 buffaloes.

Picture 8: Buffalo herd in Baobab three area

Picture 9: Buffalo herd in Baobab six area

Mgeta zone is also important for the lion population in Gonabis. The Mpingoni Camp area along the river is considered as a good habitat for the lions. The dense forest in Fumbili, where the river makes a wide meander, is considered important for Leopard. Mgeta zone is also crucial for the wild dogs population. During the group discussion and

interviews, it was found that most sightings of wild dogs were reported from the areas in the Mgeta zone, such as Mpingoni and Mpera chapa.

4.2.3 Ruvu habitats

Buffalo herds are also found in other habitat areas, namely, Kibumuke, Baobab 3 and Baobab 6. The Kibumuke herd numbers over 150 individuals and is migratory in nature, migrating during the dry season from Selous to Gonabis and vice versa. It is resident in Selous mostly from July to December. The herd in Baobab 3 numbers over 200 individuals, and like Kibumuke herd, it is also migratory. The herds migrate from Selous to Gonabis and vice versa through Lukengezua, Fumbili, Bomasai, and Niamigadou. The smallest buffalo herd is found in Baobab 6 area. This herd numbers about 50 individuals and migrates in search of water to the north of Gonabis towards the Kimero habitat. During the dry season the herd also migrates through the village land to the nearby Mkulazi Forest Reserve.

4.3 Wildlife movement patterns

Wildlife distribution in Gonabis is highly seasonal. The population of wild animals, such as wildebeest, zebra, buffalo and impala, varies considerably from season to season. With the change in season, the wild animals move not only within Gonabis but also from Gonabis to the SGR and vice versa. These movement patterns are described below:

4.3.1 Movement between Selous and Gonabis

At the onset of the dry season in June, the large herbivores migrate from the SGR to Gonabis. This is because the 30-40 km wide strip, which separates the floodplains of the rivers Rufiji and Mgeta in the north-east section of the SGR, lacks permanent water. This area, dominated mainly by Nzasa plains and Kinyanguru highland, harbors a high density of large herbivores. However, due to the scarcity of water during the dry season, the large herbivores migrate either to the Rufiji or to the Mgeta basin. Due to its proximity to Mgeta, the large herbivores from the Kinyanguru highland migrate across the river to the Gonabis lowland.

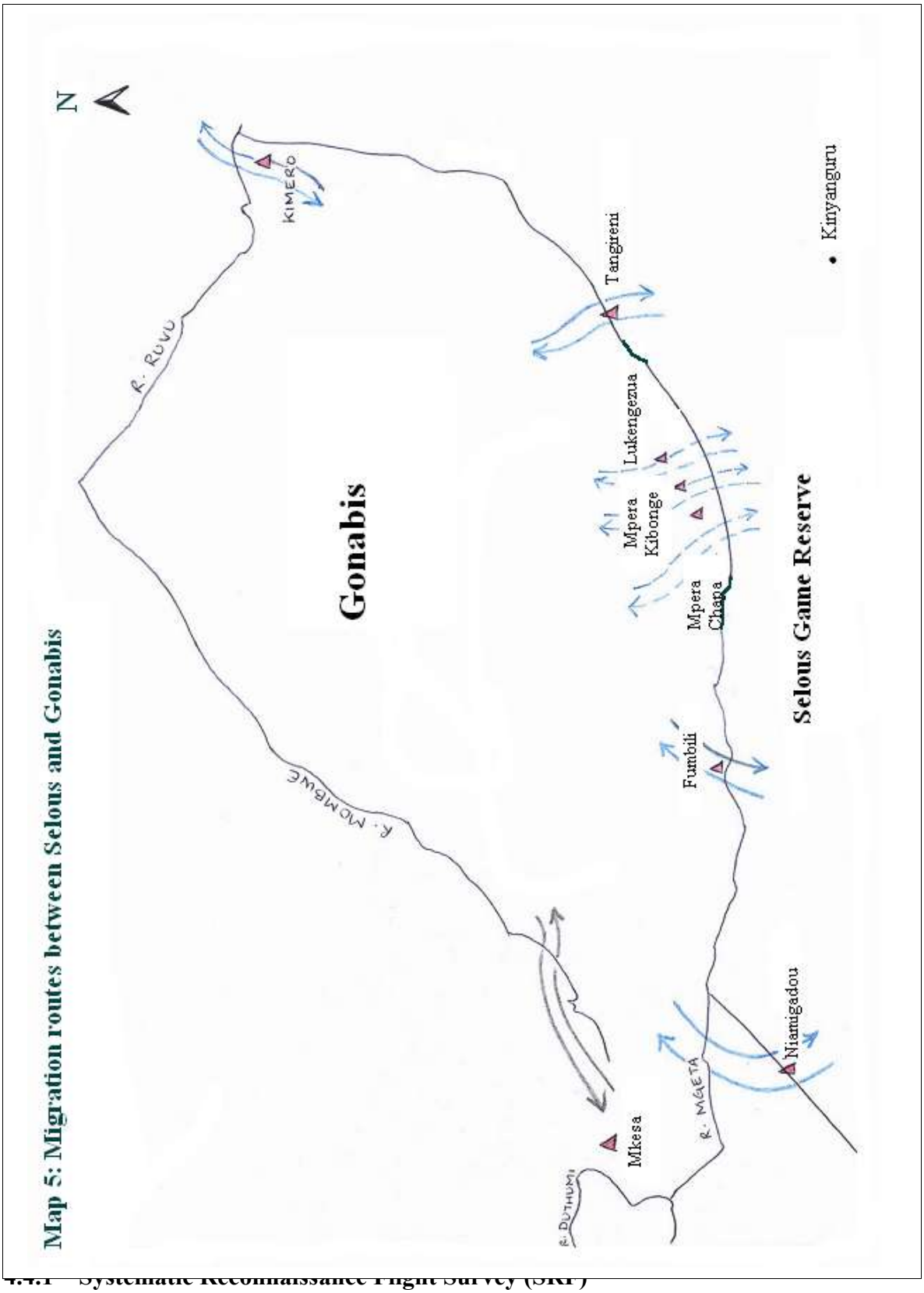
At the onset of the wet season in March, however, the cycle is reversed and the large herbivores begin to migrate back to the SGR. This is because Gonabis is a flat low lying area, which gets flooded during the wet season with water discharge from the overflowing Mgeta, Mombwe and Ruvu rivers. During this period, almost half of Gonabis is submerged under water and most animals migrate back to the Kinyanguru highland in the SGR.

Picture 10 and 11: Wildebeest and zebra migration from Selous to Gonabis in Mpera Chapa

From the group discussion with the village game scouts it was found that the animals prefer three main migration routes, which are shown in the map below. As evident from the map, the animals migrate along three main routes, Niamigadou in the west, Fumbili in the middle, and Tangireni on the east. The animals also tend to use other and less popular routes, such as Mpera chapa and Lukengezua, both located in the proximity of Fumbili. Of the wild animals that migrate from Selous to Gonabis and vice versa, wildebeest migrate the most followed by zebra and buffaloes. It is estimated that over 3000 wildebeest migrate seasonally. Elephants migrate most during the month of April, which coincides with the fruiting of the borassus trees in the riparian forest in Lukengezua area along the river Mgeta.

It may therefore be concluded that the

Gonabis buffer zone acts as an important seasonal dispersal area for wildlife.



Map 5: Migration routes between Selous and Gonabis

4.4.1 Systematic Reconnaissance Flight Survey (SRF)

TWCM in association with GTZ has conducted six five-wildlife censuses in the Selous Game Reserve and the adjoining areas. Of these, Gonabis was covered in four census

reports as a part of 'Outside North Buffer Zone'[4]. All the wildlife censuses focussed only on the large herbivores found in the Selous Ecosystem. The details of the census year and the associated information are given in the table below.

Table 4.2: SRF Surveys and areas covered in the Selous Ecosystem

Census year	Month and Season	Areas covered	Gonabis covered
1976	June, Wet	SGR, MNP, KGCA	No
1989	September, Dry	SGR, MNP, KGCA, BZs	Yes
1991	June, Wet	SGR, MNP, KGCA	No
1994	September, Dry	SGR, MNP, KGCA, BZs	Yes
1998	October, Dry	SGR, MNP, KGCA, BZs	Yes
2002	Oct-Nov, Dry	SGR, MNP, KGCA, BZs	Yes

Source: SRF Surveys, 1989 – 2002.
Note: Details for the 1976 census were not available.

As evident from the above table, most wildlife censuses were conducted during the dry season. Gonabis was covered in four census reports and all of them were conducted during the dry season. Therefore, the SRF estimates for the density of key herbivore mammal species are valid only for the dry season. The details of each census are given below:

1989 Census Report: The census was mainly conducted to provide an estimate of the elephant population. The other herbivores included in the survey were buffalo, zebra, giraffe, hippo, bushpig, warthog, wildebeest, impala, waterbuck, eland, reedbuck, sable antelope, bushbuck, greater kudu, hartebeest, and puku.

During the 1989 census, Gonabis recorded the highest density of large herbivores, with the Mgeta habitats, such as *Lukengezua*, *Mpingoni*, *Mpera Chapa*, etc, recording a density of 600 animals per sq km[5]. No other area in the entire Selous Ecosystem recorded such a high density of large herbivores. In addition, the areas in the vicinity of Gonabis also recorded a high herbivore density of 400 animals per sq km.

Such a high density of wildlife in Gonabis was mainly due to a high density of wildebeest and zebra. In the case of wildebeest, the density was as high as 600 animals per sq km, making habitats in Gonabis as the only area in the entire Selous Ecosystem with such a high density of wildebeest. The other habitat, which also reported a high density of

[4] Though Gonabis is covered in all the surveys as a part of the outside north, most animal sightings are reported from habitats located in Gonabis, with the adjoining areas reporting considerably lower densities of large herbivores. Therefore, the population estimates for the entire Outside North can be assumed as close to the population estimates for the Gonabis buffer zone.
[5] The density of large herbivores are valid only for the habitats located within Gonabis and do not represent the density of large herbivores in the entire Gonabis buffer zone.

wildebeest, was in the Northern Sector of the Selous Game Reserve. However, here the density was only 300 animals per sq km, half of that in habitats located in Gonabis. Likewise, the habitats within Gonabis reported the highest concentration of zebra and giraffe in the entire Selous Ecosystem, the density being 200 and six animals per sq km respectively.

The other large herbivores sighted in Gonabis include buffalo (low concentration), bushbuck (medium), eland (low concentration), hartebeest, impala, sable antelope, reedbuck, and warthog. No sightings were reported of greater kudu, hippo, sable antelope, waterbuck, and elephant.

1994 Census Report: The census was mainly conducted to provide an estimate of large herbivores densities during the dry season. The large herbivores covered during the census were the same as in 1989. The census recorded Gonabis and Kilombero habitats as having the highest concentration of large herbivores in the entire Selous Ecosystem.

Again as earlier, the high density of large herbivores in Gonabis was mainly due to a high concentration of wildebeest and zebra. Though, habitats in Gonabis still recorded the highest density of wildebeest in the entire Selous Ecosystem, the density of zebra was lower than in the habitats located in Selous, but higher than in the habitats located in the MNP. Giraffe densities were reported to be considerably lower than in 1989.

In contrast, the density of impalas was reported to be high, with population estimates next on to the Selous Game Reserve. Likewise, buffalo densities in Gonabis and adjoining areas were also reported to be significantly higher than in 1989. The buffalo population in Gonabis was indeed next only to the Selous Game Reserve and the Kilombero GCA. Riparian habitats in Gonabis also recorded the highest density and highest population of reedbuck in the entire Selous Ecosystem. Eland density was again reported to be low.

Unlike in 1989, this time elephants were also sighted in Gonabis, with habitats corresponding to the Mgeta zone, reporting a density of 20 animals per sq km. Waterbuck and hippo were also sighted during the survey but their density was reported to be low. As earlier, greater kudu and sable antelope were not sighted in Gonabis and the adjoining areas.

1998 Census Report: Again, the density of wildebeest is reported to be high, higher than any area in the Selous Ecosystem. The population estimates for the entire Outside North being 30,000. Though the wildebeest population was recorded as next only to the Selous Game Reserve, the density in the buffer zone was considerably higher on account of its smaller area. In case of zebra, the population estimates are next only to the MNP and the Selous Game Reserve. The population for giraffe and waterbuck were estimated to be higher than in 1994.

The density and population estimates for impala, buffalo and reedbuck were reported to be moderate, but considerably lower than in 1994. This was especially true in the case of buffaloes. Elephant, eland, and hartebeest densities remain the same as earlier. Greater kudu and sable antelope are again not reported during the survey.

Almost all the large herbivore population was reported to be distributed in the Mgeta river habitats.

2002 Census Report: As in the earlier surveys, Gonabis reported a high concentration of wildlife. The density and population estimates for wildebeest, buffalo, impala, and zebra were again reported to be high. The population estimates for wildebeest and impala were reported to be next only to the Selous Game Reserve. Buffalo densities are again estimated to be highest for the areas outside Selous, except MNP and Kilombero GCA; same is the case with the elephant, impala, wildebeest and zebra population. In fact wildebeest population is estimated to be next only to Selous and outnumbers even MNP. Impala population is estimated to be marginally higher than MNP. So is the case with the elephant population.

4.4.2 Distance Sampling Results

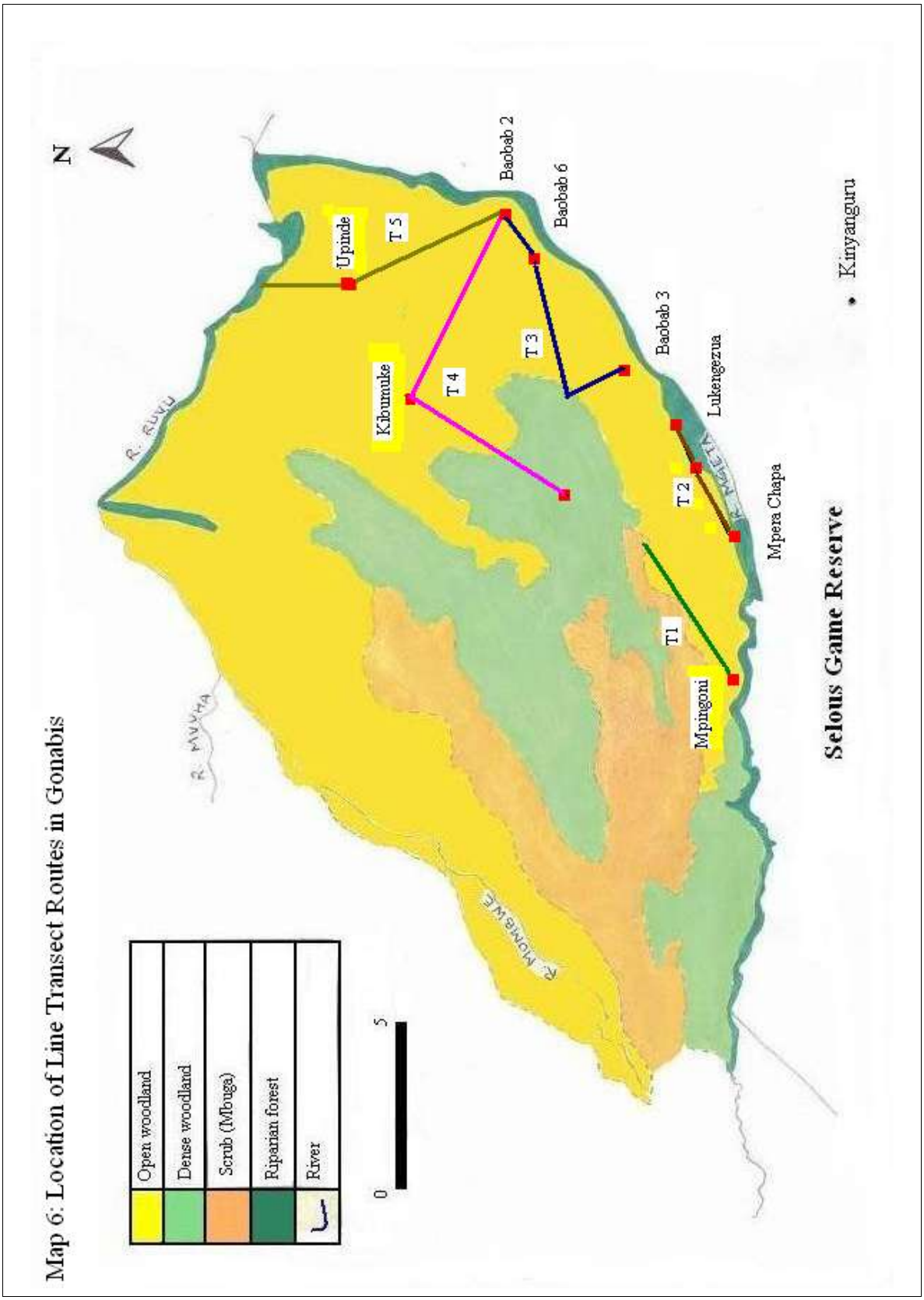
In addition to the review of the SRF survey reports, ground survey methods were also undertaken to estimate the population of three large herbivore species, impala, wildebeest and zebra. During the ground survey, five line transects were undertaken covering a total length of 40 km. The walks were designed in such a way so as to cover the three main ecosystem types found in Gonabis. However, the coverage of each ecosystem type was not in proportion to its representation in the buffer zone. The length of each walk, ecosystem type covered and animals observed are given in the table below:

Table 4.3: Profile of the transect walks

Transect No.	Transect length (km)	Ecosystem	Key species observed
1	5	Grassland, Woodland	Wildebeest, Impala, Zebra
2	5	Riparian, Woodland	Impala, Waterbuck
3	10	Grassland, Woodland, Riparian	Wildebeest, Impala, Giraffe
4	10	Woodland	Wildebeest, Impala, Zebra, Waterbuck, Buffalo, Giraffe
5	10	Woodland, Riparian	Impala, Buffalo, Giraffe
Total	40	-	-

Source: Primary survey, 2005.
Note: 1. Since the number of observations was small to produce valid results, a detailed analysis was not undertaken in the case of buffaloes, waterbuck and giraffe.
2. Other animals observed during the transect walks included elephants, warthogs, baboons, reedbuck, and hippopotamus.

As evident from the above table, the effective transect length in the case of impalas was 40 km and 25 km in the case of wildebeest and zebras. Therefore, the total length of the line transect was in adherence to the recommendations of the pilot study.



During the five transect walks, 59 clusters comprising of 1406 large herbivore mammals were observed. Of these, 20 clusters were of impala, 11 of zebra and 10 of wildebeest.

Therefore, impala was the most observed species, followed by zebra and wildebeest. The remaining clusters were that of waterbuck (6), buffalo (4), giraffe (3), elephant (2) and one each of reedbuck eland, and hippo (for details see Table 4.5). The mean cluster size and sighting distance varied from species to species and the details are given in the table below:

Table 4.4: Profile of species observed during the transect walks

Parameters	Impala	Zebra	Wildebeest
n	20	11	10
K	1	1	1
L	40	25	25
n/L	0.5	0.42	0.38
CV (n/L) %	22.36	30.00	31.62
Model	Half Normal Cosine	Half Normal Cosine	Half Normal Polynomial
ESW	186.03	351.84	256.87
Average cluster size	22	11	44
CV %	36.33	24.24	37.01
E (S)	22.05	8.12	81.72
D	29.63	4.88	61.19
CV %	47.43	56.54	91.40
DS	1.34	0.60	0.75
CV %	30.50	45.18	45.83

Source: Primary survey, 2005.
Note: n = Number of observations; K= Number of efforts; L= Length of line transect;
ESW = Effective strip width; n/L = Encounter rate; CV = Coefficient of variation;
E (S)= Expected value of cluster size; D= density estimate;
DS= estimate of density of clusters.

To estimate the density of each species, first the data were pooled over the entire survey and detection probability curve was drawn using the Distance 4.1 software. This was done to find out if there is any evidence of heaping in the data collected. However, since the number of observation was small in case of all the species, truncation of observation was not undertaken[6]. Instead, automatic class intervals were redefined so as to obtain a curve with a broad shoulder.

[6] Truncation of observation resulting in the generation of a warning by the Distance Software saying that the number of observation small to for a reliable density estimate.

Table 4.5: List of species observed during the transect walks in Gonabis					
Species	Scientific name	Observation	Species	Scientific name	Observation
Impala	Aepyceros melampus	2	*Zebra*	Equus burchelli	3
		1			25
		27			3
		150			15
		2			25
		45			4
		1			17
		3			5
		1			5
		1			16
		1			3
		2	*Buffalo*	Syncerus caffer	2
		30			200
		50			20
		5			7
		60	**Waterbuck**	Kobus ellipsiprymnus	3
		13			3
		5			5
		50			5
		2			1
		3			1
		100			6
Wildebeest	Connochaetes taurinus	5			6
		10			1
		150	*Elephant*	Loxodonta africana	1
		100			3
		10	**Reedbuck**	Redunca redunca	3
		32	**Eland**	Taurotragus oryx	17
		19	**Hippo**	Hippopotamus amphibius	1
		17			
		3			
		100			

Secondly, AIC values were computed for five models, namely, half normal cosine, half normal simple polynomial, half normal hermite polynomial, hazard rate simple polynomial, and hazard rate hermite polynomial. The model with the minimum AIC value was then selected for the detailed analysis.

In case of impalas, half normal key function with cosine series expansion was selected over the other key functions because of minimum AIC value. Given the fact that impala was the most observed species, the encounter rate at 50 % was higher than for zebra (42 %) and wildebeest (38 %). The coefficient of variation for the encounter rate was also the lowest in case of impala, showing better consistency of data. The average and the

expected cluster size in case of impalas were almost similar at 22 animals. The density of impalas in Gonabis was found to be 29.63 animals per sq km, with the cluster density of 1.34. However, the coefficient of variation in case of number of animal density was high at almost 50 %, still the estimate was close to the density estimate provided by Rodgers in 1991 for the Selous Ecosystem - 26 animals per sq. km.

In case of zebras, again half normal key function with cosine series function was selected because of minimum AIC value. The encounter rate in case of zebras was higher than that of wildebeest; so was the case with the coefficient of variation for the encounter rate. The average cluster size for zebra was 11 animals per cluster, the coefficient of variation being lower than 25 %. In contrast to impala, the density of zebra in Gonabis was found to be low at 4.88 animals per sq km. The coefficient of variation was again high at 56.59 %. The cluster density stood at 0.6 per sq km.

In case of wildebeest, half normal key function with simple polynomial series function was selected. The encounter rate for wildebeest was lower than the other two species, despite the fact that wildebeest is amongst the most abundant species found in Gonabis. This is mainly because wildebeest is also the most mobile of all antelopes in the Selous Ecosystem and elsewhere in Tanzania. Though the density of wildebeest was found to be high at almost 61 animals per square km, a high coefficient of variation value (91.4 %) rendered the finding as almost useless. The cluster density at 0.745 clusters per sq km at 48.5 % coefficient of variation was however more reliable.
Since the distribution of the three species varies from habitat to habitat and is found to be more concentrated along the Mgeta river zone, the population estimates based on the densities obtained was not undertaken.

Thus, it may be concluded that though the results in the case of impala and zebra density were fairly reliable and consistent, in the case of wildebeest a high coefficient of variation rendered the result as useless. This was mainly because the flooding of Gonabis at the time of the main survey, restricted free movement within the area, resulting in less ground coverage and hence small number of observations in case of all the species. Nonetheless, the results provide a reliable insight to the density of impalas and zebras at the beginning of the wet season.

4.5 Problematic species

The local communities staying in the village zone bordering Gonabis also have to bear losses on account of stray movement of wildlife beyond the boundaries of Gonabis [GTZ, 2003]. Based on the nature of these losses, they can be divided into three categories: crop, livestock and human. During the group discussion with the village game scouts and the local communities, it was found that the pattern of loss varies from village to village on account of different movement patterns displayed by different species found in Gonabis. The local communities were also asked to rank the problem species.

4.5.1 Crop raiding species found in Gonabis

Table 4.6: Rank of crop raiding species found in Gonabis

Village	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6
Bonye	Elephant	Bushpig	Buffalo	Vervet	Baboon	Hippo
Tulo	Bushpig	Vervet	Baboon	Hippo	Hare	Porcupine
Magogoni	Baboon	Bushpig	Vervet	Hippo	Elephant	-

Source: Primary Survey, 2005

As evident from the Table 4.6, the crop raiding patterns vary from ward to ward in the village zone bordering Gonabis. For instance, in Bonye while elephants were responsible for causing the maximum crop damage, in Tulo it was bushpig and in Magogoni baboons. However, four species were found to be causing crop damage across all the villages from the three wards, these were vervet, bushpig, baboons, and hippo.

Further, during the group discussion it was found that baboons, bushpig, and hippo cause maximum damage when the crops are in their preliminary stages. Vervet causes maximum damage especially when the crops are ripe, while elephants cause damage during all stages of the crop growth.

4.5.1 Livestock raiding species found in Gonabis

Table 4.7: Rank of livestock raiding species found in Gonabis

Village	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6
Bonye	Leopard	Lion	Crocodile	-	-	-
Tulo	Hyena	Crocodile	Caracal	Serval	Ratel	Lion
Magogoni	Leopard	Hyena	Lion	Caracal	-	-
Masaai	Lion	Leopard	Python	-	-	-

Source: Primary Survey, 2005

As evident from the above table, the pattern of livestock loss was also found to be different in the three villages. While leopard was found to be responsible for causing maximum livestock damage in Bonye and Magogoni, it was hyena in the case of Tulo village. In all, leopard, lion and hyena were found to be causing maximum livestock damage. Maximum damage takes place during the wet season when the grass is tall and the carnivores find suitable cover to hide. During the group discussion with the Masaai community in Bonye village, it was found that in 2004 seven cattle and several goats were killed by the species mentioned above. In defence a lion and a leopard were killed by the Masaai. Other informants indicate that the killing of lions by the Maasai was higher than given.

In Magogoni village, a cow and several goats were reported to have been killed by hyenas in 2004. Likewise, cattle mortality was also attributed to stray movement of leopards and lions in 2004.

4.5.2 Human morbidity and mortality due to wildlife in Gonabis

Table 4.8: Rank of species responsible for causing human morbidity and mortality

Village	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5
Bonye	Crocodile	Leopard	Lion	Buffalo	-
Tulo	Crocodile	Lion	Leopard	-	-
Magogoni	Crocodile	Hippo	-	-	-

Source: Primary Survey, 2005

As evident from the above table, in all the three villages crocodiles were found to responsible for causing maximum human morbidity and mortality. However the severity of the problem was restricted to Magogoni and Tulo. For instance, in Magogoni as high as 46 people were killed by crocodiles since 1999. In Tulo, 10 people were in injured by crocodiles from 2000-2003. Whereas in Bonye, 5 people were killed by leopard in the 1980s. No case of mortality from lions was reported after 1974. In addition, one person was reported to have been killed by a buffalo and one by hippo in 2002 in Tulo and Magogoni respectively.

4.6 Endangered species

Gonabis is home to one of the 11 endangered species found in Tanzania - wild dogs. In addition it is also a valuable habitat for three of the 27 vulnerable species found in the country, namely lion, elephant and cheetah, though the latter is seldom observed in the

area. During the group discussion with the village game scouts and the local communities, a special emphasis was placed on the distribution of wild dogs in Gonabis.

Wild dogs constitute one of the 11 endangered species found in Tanzania and the Selous Game Reserve is known to have the highest population of wild dogs in Africa (approx. 1,500 out of 4,600). From the group discussion with the village communities and the Village Game Scouts, it was found that Gonabis supports a small population of wild dogs, however, it is not certain if this population is resident or migratory.

During the group discussion conducted at Bonye, all the respondents reported of having seen wild dogs in Gonabis, with a pack size of about 20 individuals. The last sighting was reported in February 2004. Likewise, during the group discussion at Tulo village, two respondents reported of having sighted wild dogs at Usasa habitat area in Gonabis with a pack size of about 5-10 animals. The residents of Magogoni reported no sighting of wild dogs.

The Village Game Scouts also reported of sighting wild dogs in Gonabis. Most sightings were reported during the dry season with the pack size varying from 5-10 animals. The animals were last sighted in January 2004 in the open woodland habitats of river Mgeta and Mombwe. The pack size was small in the case of pack observed near the river Mombwe.

5.0 The Gonabis Buffer Zone: Socio-economic Profile

The MRBZ[7] is a narrow strip of land, which is bordered on the north and west by human habitations. These habitations are rural in character and comprise of 22 villages. There are over 8000 households residing in these villages with a population of over 45,000 [GTZ, 2003]. These villages are members of the JUKUMU Society, which was initiated in 1987 under the Selous Conservation Programme (SCP), with assistance from the GTZ.

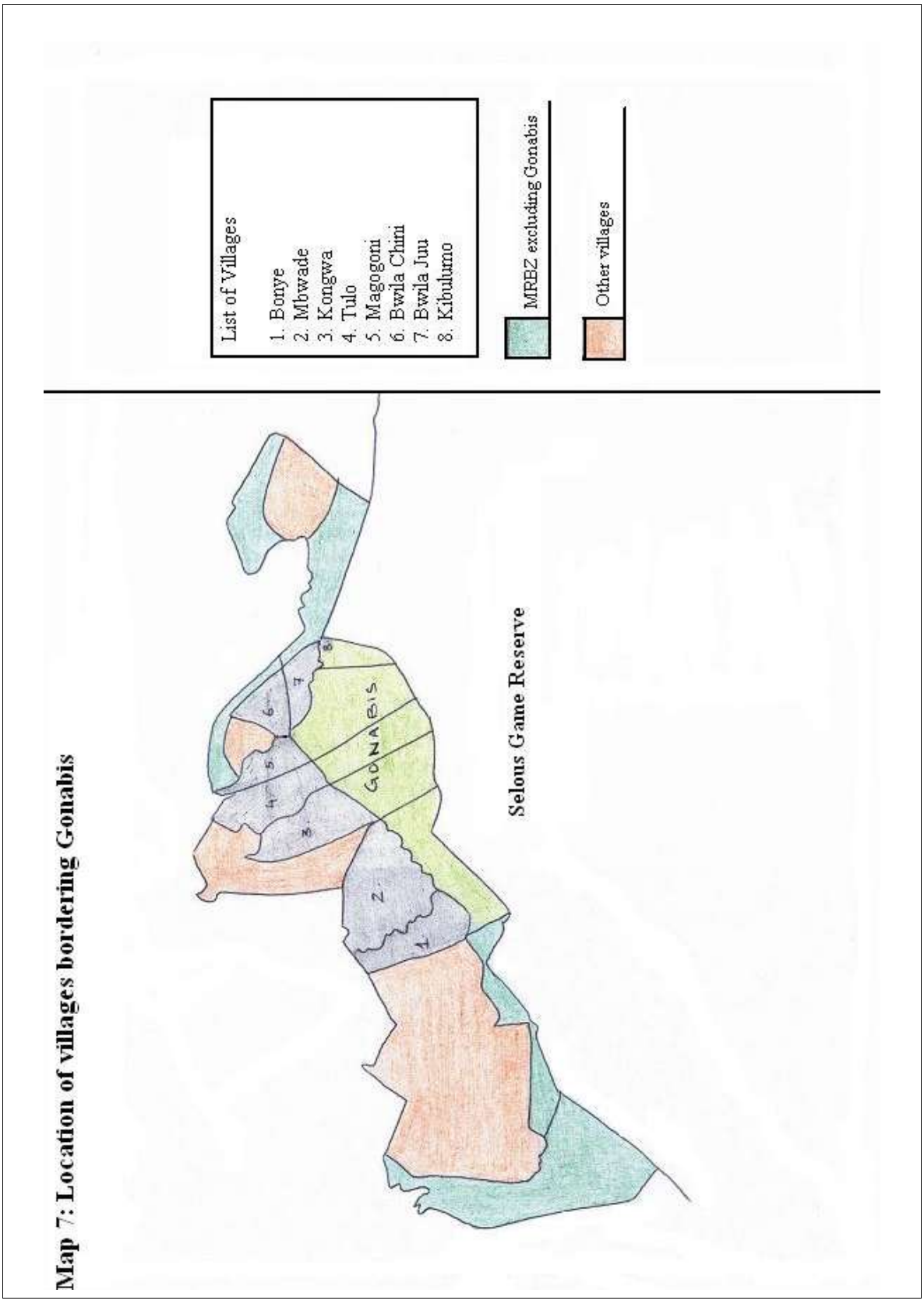
Of the 22 villages comprising the JUKUMU Society, eight villages form a direct border with Gonabis. Three of these are located on the northeast side of Gonabis, and the remaining five on the northwest. These villages belong to three wards, Bwakira, Mvuha,

[7] MRBZ is not a notified but a functional or implied buffer zone [Baldus et al (2003) on behalf of GTZ and Ashley et al (2002) on behalf of DFID].

and Selembala. The Gonabis buffer zone is actually carved out of land from these eight villages. The location of these villages is given on the map below[8].

The village zone bordering Gonabis lies at the foothills of the Uluguru Mountains, at an altitude level, which is 25-80 meters higher than Gonabis. It has a fertile land drained by five main rivers, Ruvu, Mgeta, Duthumi, Mvuha, and Mombwe. The latter is seasonal and acquires a flow only during the wet season. All rivers, directly or indirectly, eventually drain into the Ruvu. The latter, together with Mgeta and Mombwe, also defines the boundary of the Gonabis lowland.

[8] Since the data on the socio-economic profile and land use pattern for Kibulumo village was not available, the analysis was based on only seven villages. The Kibulumo village was excluded for the purpose of this research. The Village is least likely to have major influence on the research findings on account of its small size and small population.



Map 7: Location of villages bordering Gonabis

Table 5.1: Socio-economic profile of villages bordering the Gonabis buffer zone

No.	Village Name	Ward Name	Area (ha)	Population	Households	AFS

1	Bonye	Bwakira	9985	3509	585	6.00
2	Mbwade	Bwakira	6665	2685	384	6.99
3	Kongwa	Mvuha	8816	1153	231	4.99
4	Tulo	Mvuha	5373	1023	205	4.99
5	Magogoni	Selembala	14958	865	148	5.98
6	Bwira Chini	Selembala	3272	2961	370	8.00
7	Bwira Juu	Selembala	3849	881	220	4.00
	Total		52918	13097	2143	6.11

Source: GTZ, 2003.
Note: For the purpose of this study only seven villages were included as data on Kibulumo village was not available.

As evident from the above table and the map, the village zone having an immediate border with Gonabis runs consistently along its western and northern boundary. In totality, it covers an area of almost 530 sq km, of which only 116 sq km is revenue land. There are 2143 households residing in the village zone with an average household size of 6.11 and a total population of 13, 097 [GTZ 2003]. The bulk of population comprises of Bantu tribe, the chief groups being *Wakutu* and *Waluguru*, followed by *Pogoro* and *Zaramo*. The zone also has a small Masaai population almost exclusively confined to two villages, Bonye and Mbwade. Most tribes in the village zone are resident, with the exception of *Chagga*, *Pare* and Masaai; the latter also forms the largest migrant group in the village zone.

Table 5.2: Socio-economic facilities in villages bordering the Gonabis buffering zone.

Village	Water	Health	Education	Bus stop	Electricity	Post	Telephone	VC
Bonye	HP	Dispensary	PS	BS	Nil	Nil	Nil	Nil
Mbwade	HP	Dispensary	PS	BS	Nil	Nil	Nil	Nil
Kongwa	River	Nil	PS	7 km	Nil	Nil	Nil	Nil
Tulo	River	Dispensary	PS	7 km	Nil	Nil	Nil	Nil
Magogoni	HP	Dispensary	PS	10 km	Nil	Nil	Nil	Nil
B. Chini	River	Nil	PS	BS*	Nil	Nil	Nil	Nil
B.Juu	River	Nil	PS	BS*	Nil	Nil	Nil	Nil

Source: Primary survey, 2005
Note: HP = Hand Pump; PS = Primary school; BS = Bus Stop; BS* = Bus Stop with seasonal bus service; VC = Vocational College.

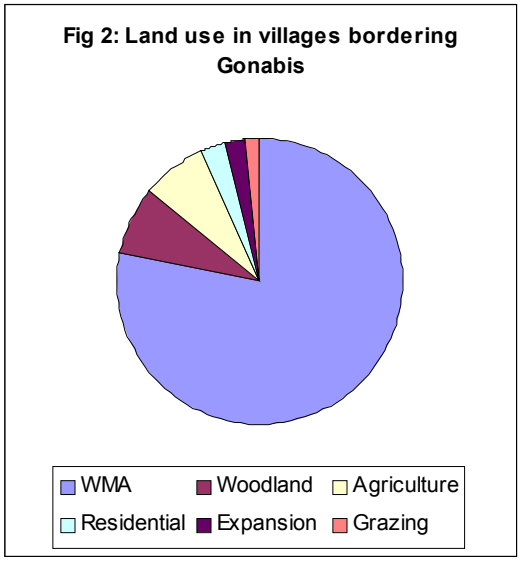
As evident from the above table, most villages in the village zone show low levels of socio-economic development. Only Bonye, Mbwade, and Magogoni have access to hand pump facility, the others have to rely on river for water supply. The primary health care facility is available at four villages, the other three villages, which are relatively remote and inaccessible during the wet season, do not have ready access to primary health care facilities. In case of transport accessibility, only Bonye and Mbwade are readily accessible throughout the year, Bwila Juu and Bwila Chini are accessible only during the dry season,

while Tulo, Kongwa and Magogoni are located at a distance of more than 5 km from the nearest bus stop. In addition, none of the villages have electricity and communication facilities. All the villages however have access to primary school. Therefore, while education and health facilities are moderate, water supply, communication, and transport are generally either poor or altogether lacking.

Table 5.3: Land use in villages bordering the Gonabis buffer zone

No	Village	WMA	Woodland	Agricultural	Residential	Grazing	Expansion	Total
1	Bonye	7845	977	821	342	0	0	9985
2	Mbwade	5145	641	635	244	0	0	6665
3	Kongwa	6667	824	692	288	345	0	8816
4	Tulo	4337	342	270	120	304	0	5373
5	Magogoni	14149	247	211	86	265	0	14958
6	Bwira Chini	1064	617	925	216	0	450	3272
7	Bwira Juu	2156	367	448	128	0	750	3849
	Total	41363	4015	4002	1424	914	1200	52918
	Percentage	78.16	7.587	7.563	2.69	1.73	2.26	100

Source: GTZ, 2003



Of the 530 sq km village area, 414 sq km (78 %) is devoted for use as the proposed WMA. 60 % of this 414 sq km area forms Gonabis, which separates the Northern Section of the Selous from the village zone.

7.6 % area is devoted to woodland, which fulfils fuelwood and timber requirements of the village zone. This is followed by land for agricultural use (7.5 %), residential use (2.69 %), for use as expansion (2.26 %) , and for livestock grazing (1.7 %). Thus, over 85 % area of the village zone is devoted to conservation activities and 9 % to economic activities. The proportion of grazing land in village zone is low on account of limited livestock rearing activities; this is because of the presence of Tsetse fly in Gonabis.

Most households in the village zone rely on farming activities and the main crops grown include: sesame, maize, banana, cowpeas, green gram, paddy, sorghum, cassava and tomatoes. A few households are also engaged in livestock rearing, mainly Masaai, the others own chickens, but not cattle or goat. Most households also engage in non-farm activities during the lean agricultural season, either as wage laborers or as small

businessmen. In a study conducted by Ashley et al in 2002, it was found that most of the agricultural produce is consumed by the households themselves, as high as 85 % in the case of maize, suggesting subsistence level of the economy.

Given the fact that the local communities in the village zone have subsistence household economy and livestock is rare due to tsetse flies, they show a high level of dependence on natural resources contained in Gonabis, mainly bushmeat, which is the chief source of animal protein in the diet of many households residing in the village zone [Baldus et al, 2003]. The bushmeat is often sold in the villages but at a price far lower than the market value of meat. Though the 22 villages in JUKUMU Society are allowed to harvest up to 60 buffaloes and 200 wildebeest, the present take off is low at 50 tons per year. On account of logistical problems and limited purchasing power, villages harvest only 30-80 % of their quota [Baldus et al, 2003].

Besides bushmeat, the local communities also harvest *milala* and *nyasi* as thatching material, *kambala*, *borassus* and *charaka* for wooden poles, timber from *mikongo*, *mninga* and *mvule*, and fish from the rivers bordering Gonabis. In addition, each year the JUKUMU society earns as much as USD 7000 as a donation from the hunting company which has leased Gonabis from Wildlife Division for tourist hunting. The tourist lodge on JUKUMU land pays an annual lease fee of around 20,000 US$ (2004).

5.1 Socio-economic profile

This chapter presents the socio-economic profile of the respondent households, such as gender, age, household size, education, land holding, and occupation. These characteristics are described below:

5.1.1 Gender and Age Profile

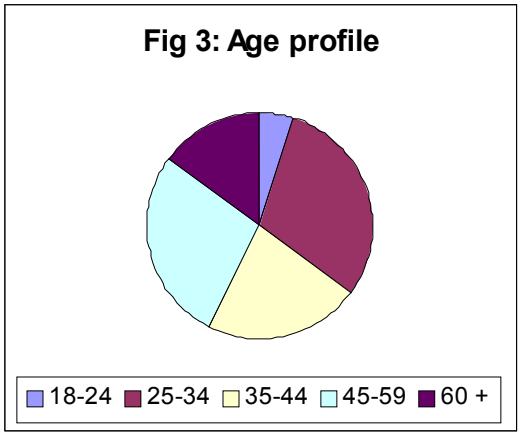
Table 5.4: Gender profile of the respondent HHs

Gender	Number	Percentage
Male	32	80
Female	8	20
Total	40	100

Table 5.5: Age-profile of the respondent HHs

Age-group	Number	Percentage
18-24	2	5.00
25-34	12 (4)	30.00
35-44	9	22.50
45-59	11 (2)	27.50
60 +	6 (2)	15.00
Total	40	100.00

Source: Primary Survey, 2005.
Note: Figures in parenthesis indicate number of women.



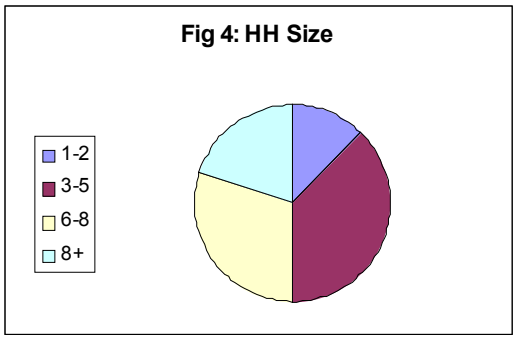
As evident from Fig 3, 20 % respondents in the sample were women. Most of them belonged to the working age group, median age being 38 years. Like females, most male respondents also belonged to the working age group. In general, 80 % respondents were from the age groups 25-34, 35-44, and 45-59. The median age of the respondent was 38.5 years. 15 % percent respondents were above 60 years and most of them were men.

5.1.2 Household Size

Table 5.6: HH size of the respondent households

Household Size	Number	Percentage
1-2	5	12.50
3-5	15	37.50
6-8	12	30.00
8+	8	20.00
Total	40	100.00

Source: Primary Survey, 2005



Most respondents had a household size varying from 3 - 8 members. The average household size was 5.95 members. Only 12 % respondents had a household size smaller than three and this was either on account of their young or old age.

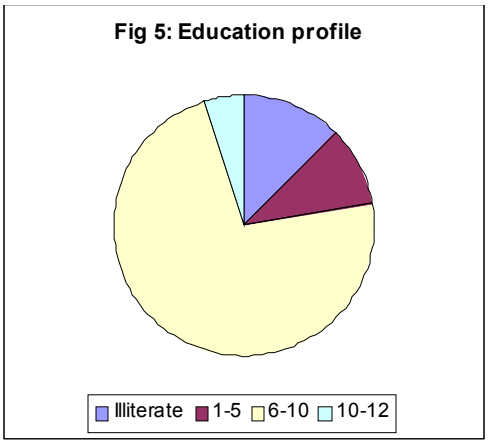


Table 5.7: Education profile

Education level	Respondents	%
Illiterate	5 (1)	12.50
1-5	4	10.00
6-10	29 (6)	72.50
10-12	2 (1)	5.00
Total	40 (8)	100.00

Source: Primary Survey, 2005.
Note: Fig. in parenthesis indicate no. of women.

5.1.4 Land Holding

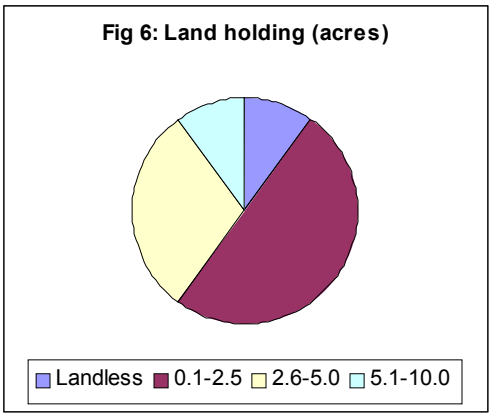


Table 5.8: Land holding (acres)

Land holding	Respondents	%
Landless	4	10.00
0.1 - 2.5	20	50.00
2.6 – 5.0	12	30.00
5.1 – 10.0	4	10.00
Total	40	100.00

Source: Primary Survey, 2005

5.1.5 Occupational profile

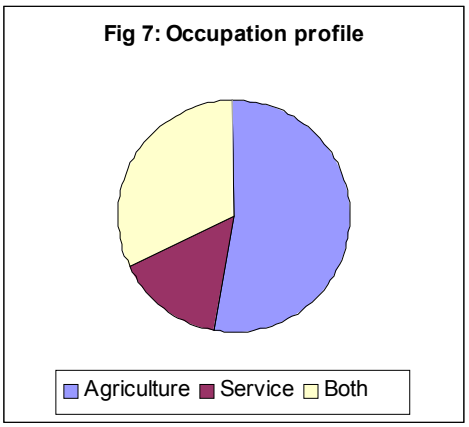
Of the 40 households interviewed, 5 had no formal schooling and were illiterate. Most of these respondents were more than 60 years old. A large number of respondents had received 6-10 years of education and the average number of years of education was 6.1 years. The degree of relation between household size and education however was low and the value of correlation coefficient (r) was 0.28. The association between age and education was negative, but not strong (r = -0.37). The average number of years of education for women was higher than that of men.

land holding was 3.45 acres. The degree of relation between household size and land holding was however weak. The average land holding per capita was 0.68 acres.

Table 5.9: Occupation profile

Occupation	Respondents	%
Agriculture	21	52.50
Service	6	15.00
Both	13	32.50
Total	40	100.00

Source: Primary Survey, 2005



Almost 50 % of the respondent households were engaged in only agriculture and another 15 % in the service sector. Nearly one third of the respondent households were engaged in both service and agriculture sector, depicting diversity of work in their occupation profile. This also indicates that agricultural is a seasonal practice and during the non-agricultural period alternative sources of employment are sought after. There is a strong link between number of years of education and households engaged in the service sector.

The summary statistics for socio-economic characteristics of the sample is given in the table below:

Table 5.10: Summary statistics

Variable	Sample characteristics	Correlation	r
Women %	20 %	Education and HH size	0.286
Median age	38.5 years	Age and Education level	-0.367
Mean household size	5.95	HH Size and Land holding	0.095
Mean education	6.1 years		
Mean land holding	3.45 acres		

5.2 Attitude of the Respondent Households

This chapter presents the attitude of the respondents towards the conservation of wildlife in Gonabis and the benefits they derive from it.

Table 5.11: Consumptive use benefits derived from Gonabis

Village	Bushmeat	Fish	Milala
Bonye	13	13	13
Tulo	20	20	20
Magogoni	7	0	0
Total	40 (100)	33 (82.5)	33 (82.5)

Source: Primary survey, 2005.
Note: Figures in parenthesis indicate percentage.

As evident from the above table, all respondents from the three villages derived bushmeat from Gonabis. More than 80 % respondents also harvested fish from river Mgeta, which forms the boundary between Gonabis and Selous. *Milala*, a plant-based raw material used for making ropes, was harvested by more than 80 % respondents. While fish and M*ilala* are harvested from Gonabis by the respondents from Bonye and Tulo, the respondents from Magogoni denied harvest the same from Gonabis.

Table 5.12: Attitude of the respondents towards the conservation of wildlife in Gonabis

Attitude variable	Very Important	Important	Not Important
Importance of Gonabis	100	0	0
Attitude Variable	Strongly agree	Partially agree	Disagree
Wild animals in Gonabis have a right to live.	100	0	0
It is our moral duty to protect wildlife in Gonabis.	100	0	0
Gonabis should be protected because it provides us with bushmeat, which is a valuable source of protein for us.	100	0	0
Gonabis should be converted to agricultural land.	17.5	0	82.5
Do you support the idea of dam construction on Ruvu that would lead to the submergence of Gonabis.	0	0	100

Source: Primary survey, 2005

As evident from the above table, all respondents felt that it is important to conserve wildlife in Gonabis. The respondents indicated a variety of reasons for the same, ranging from consumptive use to existence values. All respondents strongly agreed that wildlife has a right to live and that it is their moral duty to protect wildlife in Gonabis. The positive attitude of respondents was also evident from the fact that all of them strongly disagreed with the construction of a dam on river Ruvu, which would lead to the submergence of Gonabis. However, 17.5 % respondents, all from Magogoni village, also strongly agreed that Gonabis should be converted to agricultural land.

Two questions were used to determine the attitude of respondents towards the existence value of wildlife in Gonabis. These dealt with the right of wildlife in Gonabis to live and about the respondents having a moral duty to conserve wildlife in Gonabis. All respondents strongly agreed to both the questions. In addition, all respondents strongly agreed that conservation of wildlife in Gonabis has a consumptive use value.

Table 5.13: Priority sectors for government spending

Sector	Rank 1	Rank 2	Rank 3	Rank 4
Health and Education	40	0	0	0

Conservation of Gonabis	0	13	27	0
Drinking water	0	0	13	0
Agricultural development	0	27	0	13
Electricity	0	0	0	20
Communication	0	0	0	7
Total	40	40	40	40

Source: Primary survey, 2005

In response to the question concerning the identification of priority sectors for spending by the Morogoro Rural District Government, all respondents identified health and education as the first spending priority. More than 67.5 % respondents identified agricultural development as the second priority for spending, while the remaining 32.5 % identified Gonabis. 72.5 % rated spending on Gonabis as the third priority. Electricity and communication were the least preferred sectors for spending. Consequently, most respondents rated Gonabis as a moderately important sector for government spending, next only to health, education and agricultural development.

Table 5.14: Threats to Gonabis

Threat	Rank 1	Rank 2	Rank 3
Poaching	33	7	0
Hunting blocks	7	0	0
Poor management	0	0	13
Total	40		

Source: Primary survey, 2005

In response to the main threats confronting Gonabis, most respondents identified poaching as the main threat (82.5 %). Another 17.5 % rated hunting in the designated hunting blocks within Gonabis as the main threat. These households were also the ones who rated poaching as the second threat following hunting in the designated blocks. Lastly, a few respondents also identified poor management as a threat to the conservation of wildlife in Gonabis. All these respondents were from Magogoni.

Thus, it may be concluded that overall the attitude of the respondent households towards the conservation of wildlife in Gonabis is positive. All households from across the three villages value the consumptive use and existence benefits they derive from wildlife in Gonabis. In addition, they are also against the construction of the dam on the river Ruvu which will lead to the submergence of Gonabis, and hence the erosion of benefits which they derive from the same. However, there are regional variances in the attitude. This is evident from the fact that all the households interviewed in Magogoni also support the conversion of Gonabis to agricultural land. Further, these were also the only respondents who identified poor management as a threat to Gonabis. The negative attitude of

respondents from Magogoni can be explained by the fact that the village suffers from high levels of human morbidity and mortality owing to wildlife conservation in Gonabis. There has also been long conflict with the JUKUMU, as the village questions the boundary of the WMA and demands more agricultural land despite earlier agreement on the existing boundary.

5.3 Willingness to Pay of the Respondent Households

To estimate the consumptive use value of wild meat, households were asked to state their willingness to pay (WTP) in terms of number of labour days they are willing to provide in return for the consumptive use benefits they derive from Gonabis. Of the 40 households interviewed, only two households were against the payment and hence were 'protest households'. In accordance with the standard practice, they were excluded from the computation of the mean WTP. In response to the reasons for non-payment, both households reported non-affordability as the reason.

Table 5.15: Willingness to pay statistics

Measure	Value (Labour days)
Mean value	14 (21,000)
Median	10 (15,000)
Standard deviation	14.434
Standard error	
Maximum wtp	50 (75,000)
Minimum wtp	1 (1,500)
Total respondents	38

Source: Primary survey, 2005.
Note: Figure in parenthesis indicate Tanzanian Schilling value of labour days @ 1500 per day.

Table 5.16: Distribution of wtp (labour days)

Class Interval	Frequency
1 – 4	9
5 – 9	8
10 – 20	12
21 – 30	5
31 – 40	1
41 - 50	3
Total	38

Source: Primary survey, 2005.

As evident from table 5.15, the mean value of willingness to pay per household was 14 labour days. Given the fact that the wage rate in the region is TSh. 1500 per day, it may be concluded that each household is on an average willing to pay 21,000 TSh. in return for the consumptive use benefits. In addition all the respondents were most certain of their intention of providing the labour force.

5.3.1 Willingness to pay and socio-economic variables

According to the economic theory, willingness to pay is a function of income and preference, which in turn is determined by a number of socio-economic characteristics. Consequently, to identify the influence of these variables, the value of correlation coefficient between WTP value and socio-economic variables was used. The results are given in the table below:

Table No 5.17: WTP and Socio-economic variables

Variable	Correlation value
Gender	-0.091
Age	0.284
Education	-0.380
Household size	0.018
Land holding	0.367

Source: Primary Survey, 2005

As evident from the above table, there was a weak but positive correlation between land holding and WTP. This means that WTP of the respondent household did not increase proportionately with the rise in land holding, even though higher land holding per capita implies a higher income per capita. This is because the payment mechanism provided to the households was number of labour days and not cash. Consequently, households with higher land holding per capita or higher income per capita, as expected, were not willing to work as labour for many days. In contrast, households with smaller land holdings per capita had more time to spare and consequently were willing to provide more labour days in return for the consumptive use benefits they derive from Gonabis.

The influence of education as expected was negative, for with rising education fewer households would be willing to provide or work as labour. The influence of other variables, such as household size, and age was minimal. Interestingly, the correlation between gender and WTP was also found to be positive. This was probably because women were reluctant to provide labour work on account of strenuous daily routines.

5.4 Validity of CVM Study

To check the validity of the CVM study, the WTP of the respondents was compared with their attitude towards wildlife conservation and land holding.

In first case, the WTP of respondents was compared with the attitude score of the respondents, so as to check for consistency between the two. It is likely that respondents

with higher WTP will also have a higher attitude score. Based on this rationale, the attitude score was constructed by assigning each attitude question an equal weight and by treating the response to these questions as prescribed in Table 5.18. Thus a respondent had the possibility of having a minimum score of -7 and a maximum score of 14.

Table No. 5.18: Attitude score calculation

Response	Points
Strongly agree	2
Partially agree	1
Don't know	0
Disagree	-1

At first the protest households were examined. It was found that both the protest households had a high positive score of 12 and 14 respectively. Therefore, negative attitude towards the conservation of wildlife in Gonabis is not the reason for the protest nature of these households. On examining the socio-economic parameters of the two households, it was found that while the first respondent is male the other is female. Both are above 60 years of age. In addition, the first household is a single person household with no land holding, while the second household has low land holding per capita. Thus, in the case of the first household, the reason for the denial to provide labour work was old age coupled with single person household. In the case of the second household, it was old age coupled with gender. Consequently, negative attitude was not the reason for the protest response by both the households. In addition, in response to the reasons for non-payment, both households reported old age as the reason.

On examining the households with high WTP, it was found that these households had an attitude score between 13 and 14. Thus, their high willingness to pay was explainable on account of their positive attitude. The households with lower willingness to pay also had a relatively lower score than households with higher willingness to pay. Incidentally, all these households were from Magogoni village. In general, the respondents from Tulo village were found to have most positive attitude followed by respondents from Bonye and Magogoni.

In addition to the attitude, the land ownership of the households was also compared with the corresponding WTP and plotted on a graph. As has been explained before, there is a low but positive degree of correlation between land holding and WTP. This was because households with high land holding per capita were obviously not willing to work as

labour for many days. Thus, the WTP quotes were in consistent with the economic theory.

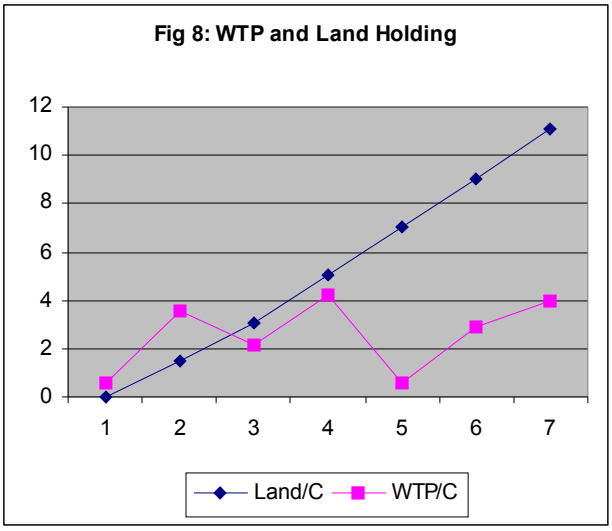


Table 5.19: WTP and Land holding

Land holding/c	WTP Value/C
0	0.59
0.15	3.53
0.305	2.14
0.505	4.19
0.705	0.61
0.905	2.89
1.105	4.00
r	**0.367**

Source: Primary survey, 2005.
Note: C = Capita
WTP= Willingness to pay in labor days per capita.

6.0 Conclusion and Suggestions

Gonabis, which is the main hunting block of the JUKUMU proposed WMA, supports a wide variety of ecosystems. These range from riparian forest along the banks of Mgeta and Ruvu, to dense woodland in the center and open woodland on the east and along the banks of the river Mombwe.

The ecosystems found in Gonabis harbor as many as 21 important wildlife habitats, most of which are located on the banks of Mgeta and Mombwe. These habitats support a high density of wildlife, especially large herbivores, such as wildebeest, zebra, impala, giraffe, reedbuck, waterbuck, buffaloes and elephants. In addition, they also provide home to endangered species, such as wild dogs, and vulnerable species as elephant, lion and cheetah.

SRF surveys reveal that Gonabis has among the highest concentration of wildebeest, buffalo, giraffe, impala, reedbuck, waterbuck, and zebra in the entire Selous Ecosystem. The Distance Sampling survey of three species, impala, zebra, and wildebeest, has revealed that the density of impalas and zebra in Gonabis is high. Though the survey revealed a high density of wildebeest in the area, a high coefficient of variation has rendered the finding as almost useless.

Besides having a high density of wildlife, Gonabis is also an important dispersal area for wildlife found in the northern sector of the Selous Game Reserve. Each year thousands of wildebeest, buffalo, zebra, and impala migrate from the northern Selous to Gonabis via three important routes, Niamigadou in the east, Mpera Chapa in the middle and Tangireni in the east. Thus if the integrity of Selous Ecosystem is to be maintained, it is essential that wildlife continues to have access to the dispersal areas in Gonabis.

Gonabis is surrounded by human habitation on east, west and north. This habitation comprises of 22 villages of which eight villages share an immediate border with Gonabis. During a socio-economic survey conducted in this zone, it was found that on an average a respondent is 38.5 years old, has a household size of almost 6, education up to the primary level, and a land holding of 3.45 acres. Most households in this zone are engaged in subsistence agriculture and almost one-third work as laborers during the lean season.

These households derive a number of benefits from Gonabis, which range from procurement of bushmeat and fish to the collection of non timber forest products. Consequently, the households have a positive attitude towards the conservation of wildlife in Gonabis. This is demonstrated by the fact that all households regard Gonabis as an important area for the conservation of wildlife, wildlife has a right to live, it is their moral duty to protect wildlife, and that wildlife provides them with consumptive use benefits. Most households are also against the conversion of Gonabis into an agricultural land and all are against the construction of a dam on the river Ruvu, which will lead to the near complete submergence of Gonabis under water. Magogoni is the only village, which is in the favor of the conversion of Gonabis into agricultural land. This is because human morbidity and mortality accruing from wild animals is highest in Magogoni, demonstrating a need to manage the problematic species in Gonabis.

The positive attitude of households is further evident from the fact that on an average each household is willing to provide 10 labor days per annum in return for the consumptive use benefits they derive from Gonabis. This amounts to a cash value of TSh. 15,000 per annum. The value of WTP was found to be in consistence with the socio-economic variables and behavior. This is because WTP values were, as expected, found to be negatively correlated with gender and education, and positively but weakly correlated with land holding and age.

Therefore, it may be concluded that Gonabis has an immense ecological value for the healthy maintenance of the Selous Ecosystem and that local communities living on the fringe of Gonabis are interested in conserving wildlife in Gonabis and willing to provide labor work for the same, in return for the consumptive use benefits they derive from Gonabis.

The ecological, social and economic value of the area as revealed by the study can play a significant role in preventing the loss of biodiversity in Tanzania and in averting the government in taking a decision in the favor of conservation activities, needless to mention such studies can also assist a biodiversity planner in better management and financing of biodiversity conservation, which in the words of Professor Pearce, is akin to investing in stocks of knowledge and capital!

7.0 References

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